2024 CAMERON KLEPAC UNREAL ESTATE

UNREAL ESTATE

By Cameron Klepac

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1.

The Lugubrious Kismet of Affordable Housing Systems

Why does everyone have to have their own home? A wise man once said you should love thy neighbor.

Of all of the crises facing the world today, there is often one that comes up in discussion of American society that has stayed at the forefront for years and years, the crisis of housing. Housing has always been a hot topic of discussion and debate in the realm of architecture, but never has it been in such a delicate (*or perhaps delirious*) and dire state before; not even 2008 could compete with today's absurd state of housing.

The overwhelming majority of housing today is created by real estate developers with the intention of selling a product, and yet hardly anyone can afford homes that were built as cheaply as possible for as many people as possible. In fact, of those that can afford housing, many don't even live in their houses, instead renting them out or leaving them unoccupied as assets to *hold money*, a tactic that might even catch The PriceMaster dumbfounded. And although architects still design plenty of homes and have them published in magazines, this scarcity and crisis of housing is largely left out of most discussion. Ever since the housing boom following WWII, responsibility for housing production has largely been left to banks, developers, and investors, who are often more concerned with the fiscal qualities of homes.

This abdication has, on one hand, produced a tremendous amount of housing and money, but, on the other hand, has degraded the quality of our environments. Homes have become separate from the communities they inhabit, and despite their quantity, have failed to supply quality housing to society at large. It is evident that our current model for home production, though profitable and efficient, is not sustainable with the issues surrounding how our housing space is organized.

It is my personal belief that architecture has a responsibility to propose alternative forms of housing, not just in terms of tectonics or construction, but in terms of organization and social norms. Our current forms of housing were created after WWII, nearly one hundred years ago, and while they worked well for many decades, it is clear that a new paradigm shift is necessary for people to afford housing and live sustainably.

One thing that the real estate developers have done correctly in contrast to architects is their utilization of technology and standards, primarily in the form of prefabrication, to produce housing at scale. While the *"cookie-cutter"* homes are often cited as a failure in terms of their architecture, their utilization of repetition and standardization are essential for creating housing.

As great as it would be for every house to be individually designed for a specific client, it is a better use of the architect's time to create a system of housing that can be repeated, scaled up, and adaptable to a wide variety of dwellers. Modernism, with all its faults and failures, recognized this fact and wrestled with it throughout its time as the architectural zeitgeist.

This was at a time when technology was extremely limited, largely limited to specific manufacturers and factories; prefabricated structures in the form of concrete panels and steel beams were cutting edge at the start of Modernism.

Today, our technology is more advanced than we give it credit for, and it continues to evolve at a pace that few can keep track of. Today, one is able to print part of a house, one is able to generate a design from parametric scripting, and one is able to fabricate nearly any shape of structure, remotely. This goes without mentioning the factor of Artificial Intelligence, which is soon expected to change every aspect of life across all of society.

Despite this, architecture has remained relatively stagnant in its relation to technological advancements. For example, while 3D printing has been around for many years, it is only now being explored in its potential to shape our environment, with avant-garde firms like B.I.G. only recently using 3D printing in 2023. While you could say that architecture as a profession has been reluctant to explore new technology, it is the result of a *long line of failures* in the 20th century, many of which were accompanied by debt and bankrupcy.

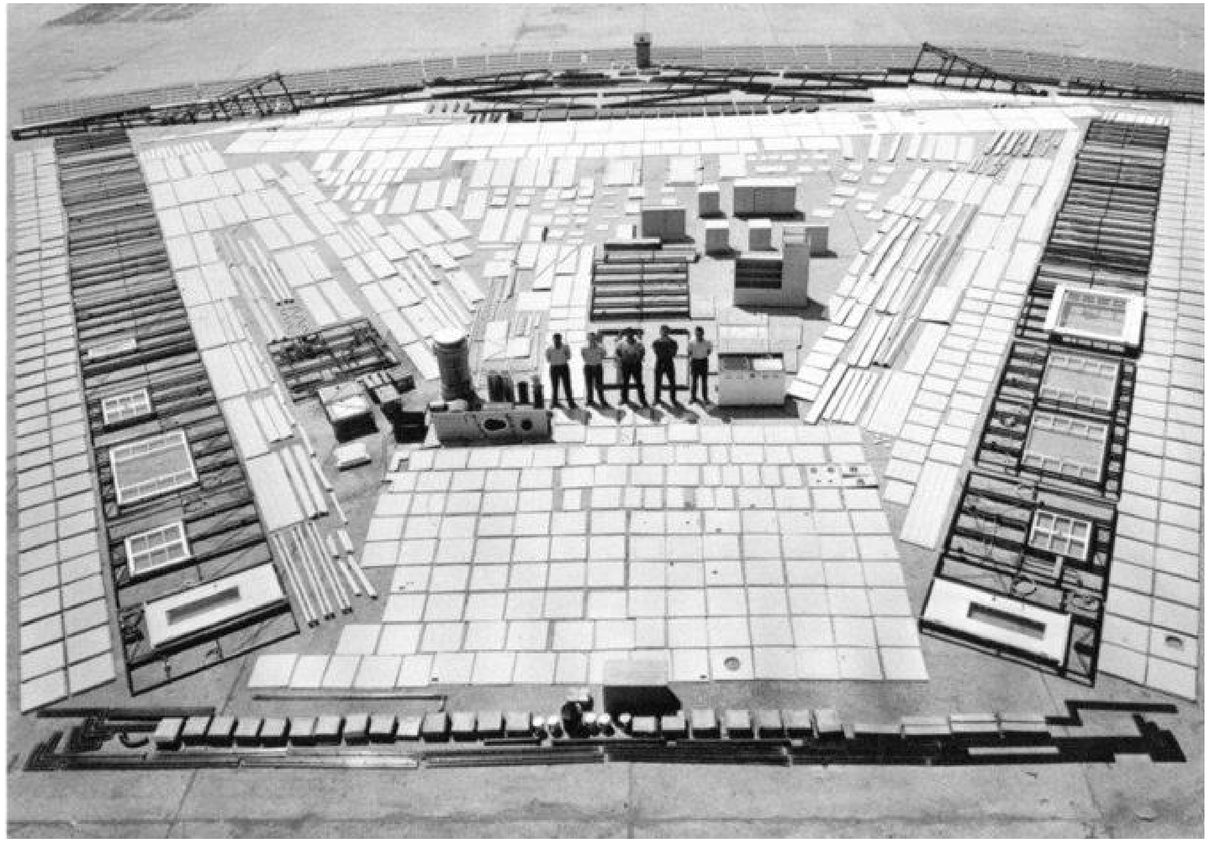
Many of the master architects of the 20th century attempted to find new systems of housing long before contemporary technology made it easy(er). Architects like Walter Gropius, Buckminster Fuller, and Paul Rudolph, to name a few, all experimented extensively with prefabrication as a strategy to bring quality, architecturally significant homes to people at a mass scale. Although their prototypes utilized new technologies and were designed to be produced at scale, all of them failed in their pursuit to reach the same scale of real estate developers. An uncomfortable number of home construction companies started by architects and designers went *bankrupt* within years of their founding, like the Lustron Corporation, among others. It is no wonder that architects today are reluctant to dive into the new and novel as it relates to housing; there is an extensive history of failures when it comes to finding a new way to produce housing.

However, despite architecture's *horrendous* track record in competing with big developers, architecture has been made better by its failures. The failed prototypes of the 20th century have made it clear that the problem of housing is tied more to how society has structured housing rather than how housing is produced. The problems of housing, then, are really more cultural than

Ben Dreith. BIG and ICON design 3D-printed campground hotel in Marfa.

technological or logistical. The systems that were created for house design in the 20th century, after all, were produced at scale in factories and were logical and well laid out in terms of design. However, producing one house at a time, per person, is simply too prone to error and too expensive to be done efficiently if it is to have architectural significance. It seems, rather, that architecture should strive to create an *alternative system of housing* as much as it should strive to create alternative housing. The most successful housing prototypes of the past 100 years have not been houses that were replicated and made in a factory but have been systems of organization and construction that could be adapted and grown over time.

My own interests lie in this discrepancy. The physical form of the house is, largely, not the design issue that needs resolving, *it is the systems that make up housing*, in construction and organization (and culture too).



MoMA. Lustron House.

Remember SEARS? They used to sell houses too, you know.

Architecture should provide new ideas of housing, and it should do so with new methods of design and construction.

For a system of organization, then, it seems highly appropriate to use parametric modeling as a design strategy. As tempting as it is to cavort around with the cutting edge of AI, it is still not so great with architecture, yet. With the proper parameters coded into a script, though, a parametric approach could be scaled to fit nearly any context and scale, and with little to no error.

To begin my own approach to designing alternative housing, I started with parametric modeling, via Grasshopper in Rhino 7. Taking inspiration from the Modernists, manufacturing standards were used as the basis for much of my parametric forms. Everything is confined to 8′ increments to take advantage of the industry standard for timber structures, plywood paneling, and so forth. And rather than have the parametric script create a straight, banal line of 8′ increment units of houses, it seemed more appropriate for the script to run on a predesignated line. Having to feed the script a line adds some amount of *authorship and control* over the organization that the script provides, while maintaining its simplicity.

This approach, while using Grasshopper and computer voodoo, is not dissimilar to Habitat 67, one of the more famous examples of alternative housing, both in design and in implementation.

Safdie Architects. Habitat 67.

Habitat 67 was a final study project.

They don't make 'em like they used to.

Safdie Architects. Habitat 67.

Well, I guess this book will have to do.

Doggone, where's my $22,400,000?

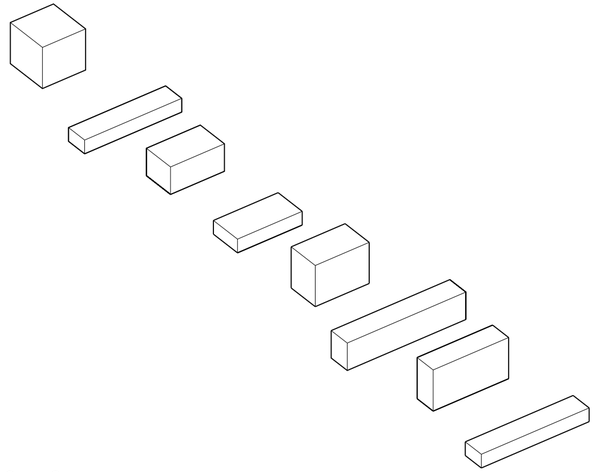
Using a parametric script gives us forms that are logical and introduce variety through the line(s) fed to it, which, depending on its path, causes forms to intersect and connect in many interesting ways. Such forms are easily resolved using mass timber, CLT, or concrete (concrete being a favorite of the 20th century, including Habitat 67 and much of Le Corbusier's work). However, the interior requires the touch of an architect in order to have any sort of meaningful coherence.

The structure of the building, determined almost entirely by Grasshopper, can be cut and bolted together with a high degree of repetition; it is largely only the interior that is tricky to manage. Thanks to me from the past, the parameters set in the beginning of the project allow everything in the interior to be organized according to 4′, 8′, and 12′ modules, though not without many little imperfections and odd instances where units meet one another.

As we shall see, even with everything generated parametrically to specific standars, it turns out that developing a system of housing is *mega difficult*. It is no wonder that the kismet of housing systems is lugubrious, few, if any, have truly created a lasting and meaninful alternative to the systems of housing that we have in place.

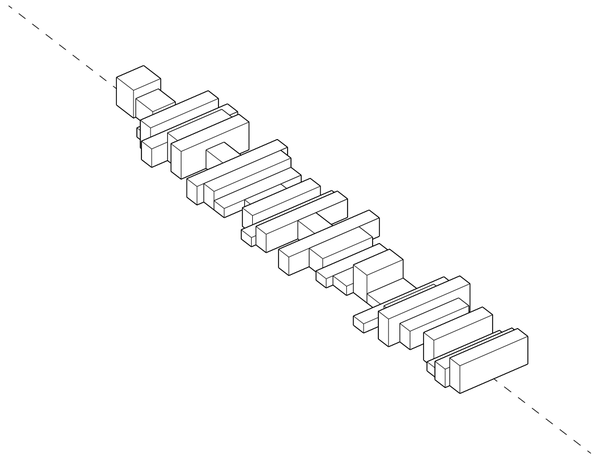
Step 1:

standardized block forms generated at random



Step 2:

blocks are smashed together along a chosen line
(I know I said I wasn't doing a straight line 2 pages ago, this is just an example)



2.

Perfunctory Vacillation

Now that we have a script that generates juvenille architectural forms, we need somewhere to put it. Because the script generates everything to standards that can be resolved with CLT, it essentially can be placed in nearly any site with enough care and work on details. Given this, it seems appropriate to use a blank slate, per se, to experiment and see what can be generated with nothing to work around.

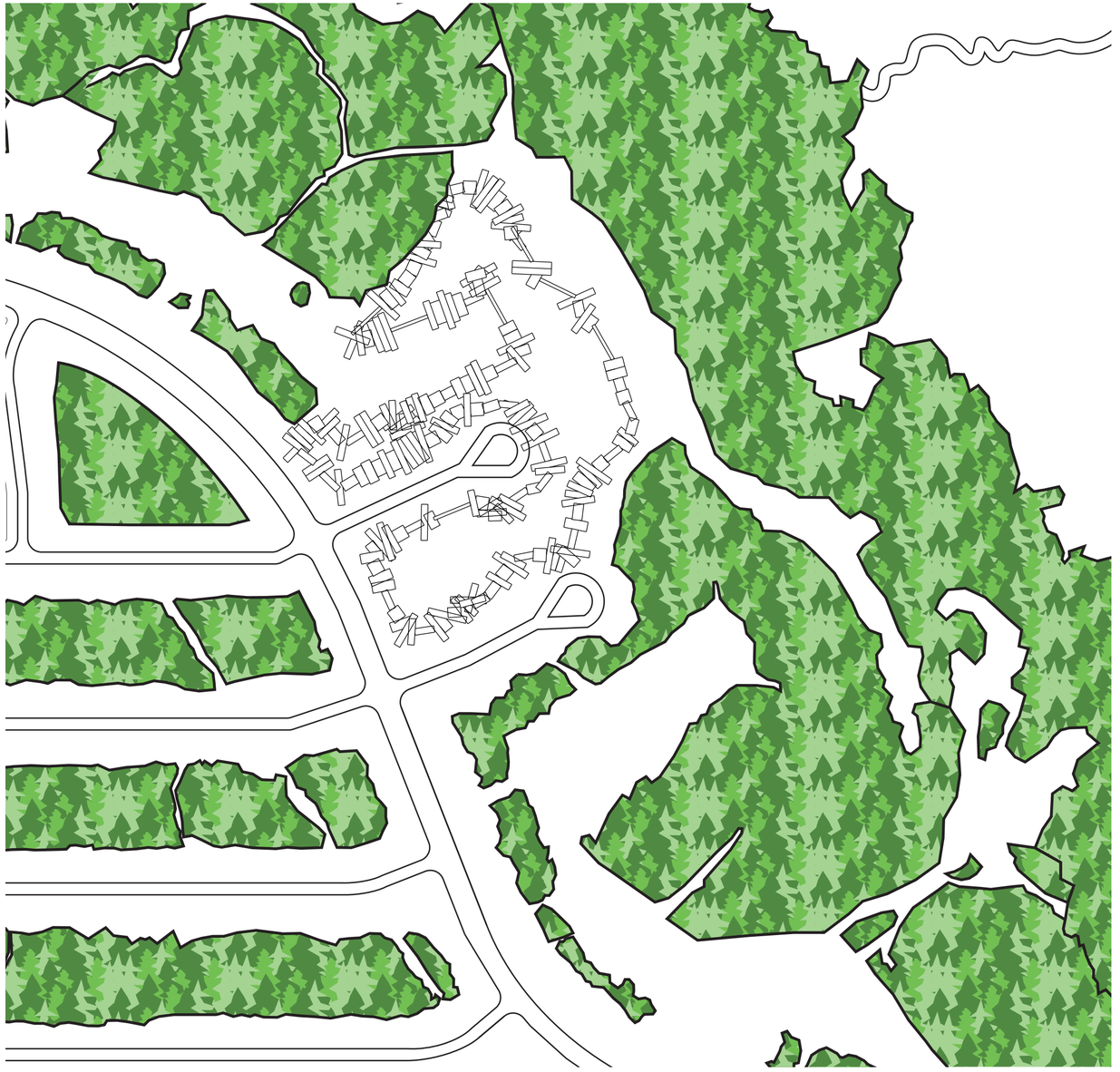
Plum Grove, Texas, was chosen as the site for this project. If you glance a little up and to the right, you'll see that the name is very misleading, as there is a severe lack of plums, and it's not very grove-like in its current state. The city is a new development at the time of this book, and largely empty, save for a few homes scattered here and there on the freshly cleared land. It is about 30 to 40 minutes from Houston's downtown, located North-East from Houston. Its residents are mostly lower income and many are immigrants. As it is a prime target for real estate developers, it seems a fitting site to deploy an alternative and unconventional housing development.

Most projects would give you site conditions and research at this point, but the goal of this project is not necessarily to design a building (and frankly, does anyone *really* pay attention to that stuff?). Instead, this project seeks to explore how one may develop a system of housing from scratch, a system that challenges norms of housing while maintaining a degree of repitition and modularity while utilizing new(ish) design technology.

Plum Grove, Texas. Taken from Google Earth.

To start, a random bit of forest was chosen to be the site for deploying the script. The border of the forest was outlined, the outline served as the line for which the script was to work with. As you shall see, this provided an interesting formation of buildings. It also provided more buildings than I could possibly design in detail on my own, so only a small chunk of the overall formation was chosen to work on. Since the script generates forms parametically, much of the designs that will resolve the interior can be repeated in other parts of the overall project. And, thanks to the odd, wonky line from the forest, we get many odd, wonky spaces generated by the script; many of the forms intersect and collide with each other in odd ways.

50'
200'
100'
400'

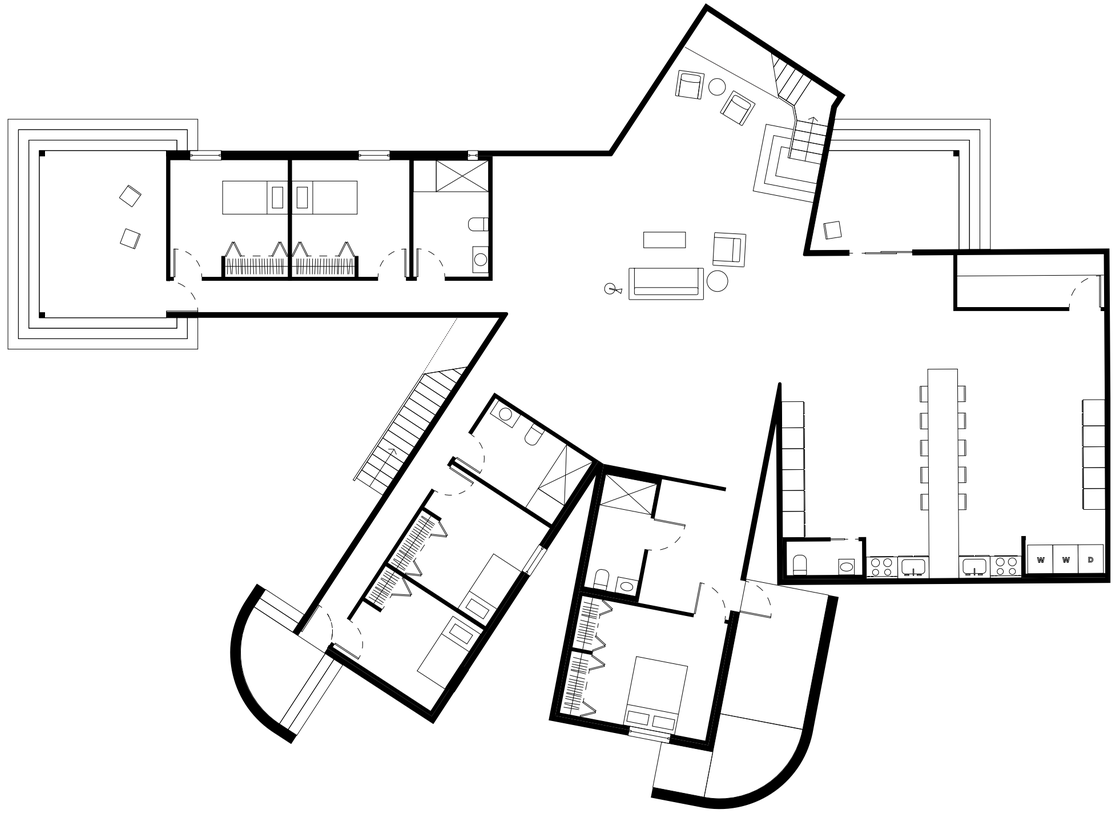


For all of the reptition given to the form of the project, there is no shortage of areas that are unique. While this could be seen as a fault of the script, it acutally serves to inject a lot of architecture into the product of the script. The intersections and collisions in the script allow for an intervention on the part of the architect; much of the project is just repeated and shifted around, but the odd spots require a very intentional design approach.

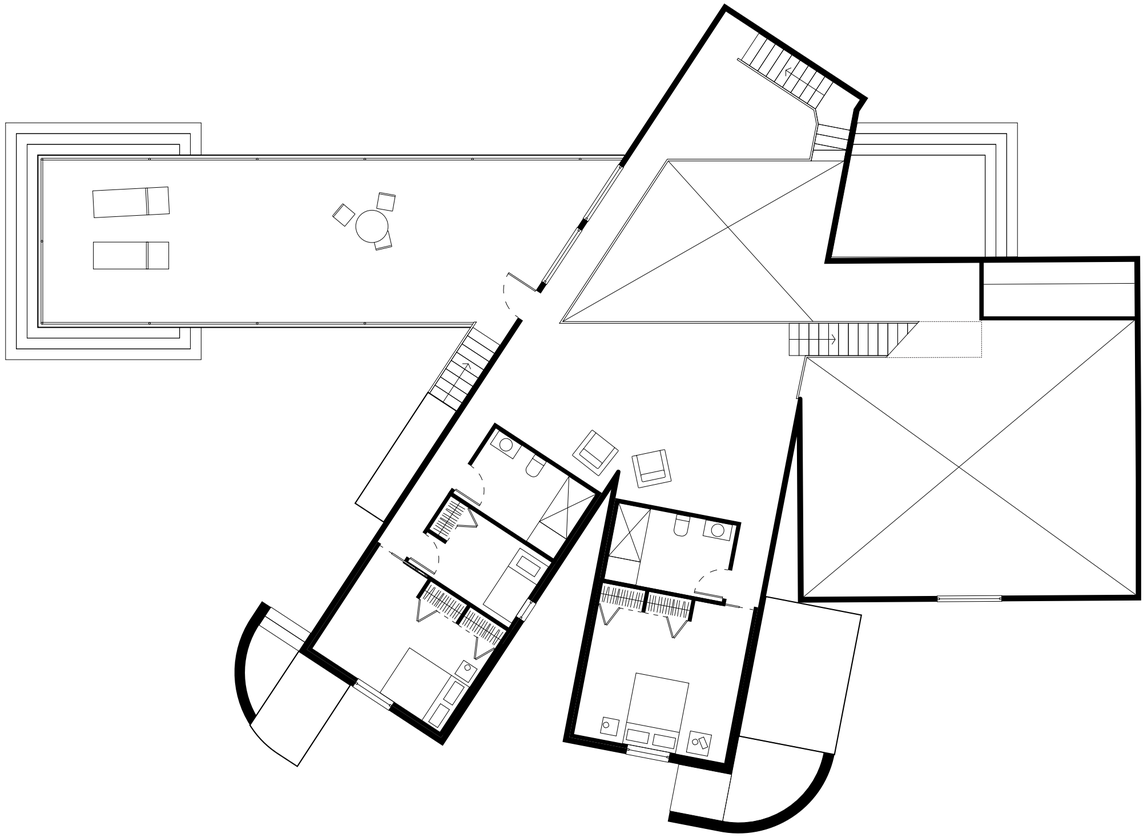
These odd spots also allow for an alternative idea of housing, as they are, or must, be shared between several blocks or "units". Rather than try to squeeze in bedrooms and bathrooms into the uneven spaces, they become large and open living spaces to be shared between all of the inhabitants of the building. This not only gives the dwellers a generous space to inahbit, but encourages (dare I say forces) them to socialize and form relationships with each other. If you share your kitchen or living room with 5+ people, you will probably get to know them well. Without any intention, the script facilitates community building by way of its use by the architect in charge of it.

As for the parts of the building that are standard and repeated, we simply fill them in with bedrooms and bathrooms, forming a sort of make-shift dorm style living arrangement. With a little tweaking around the edges, we are able to create ADA units for the project at the ground floor. With a little more tweaking, we are also able to create shared outdoor spaces that compliment the indoor ones. And, with flat roofs given by script, it seems such a waste to leave them as they are, so they are made to be usable outdoor space.

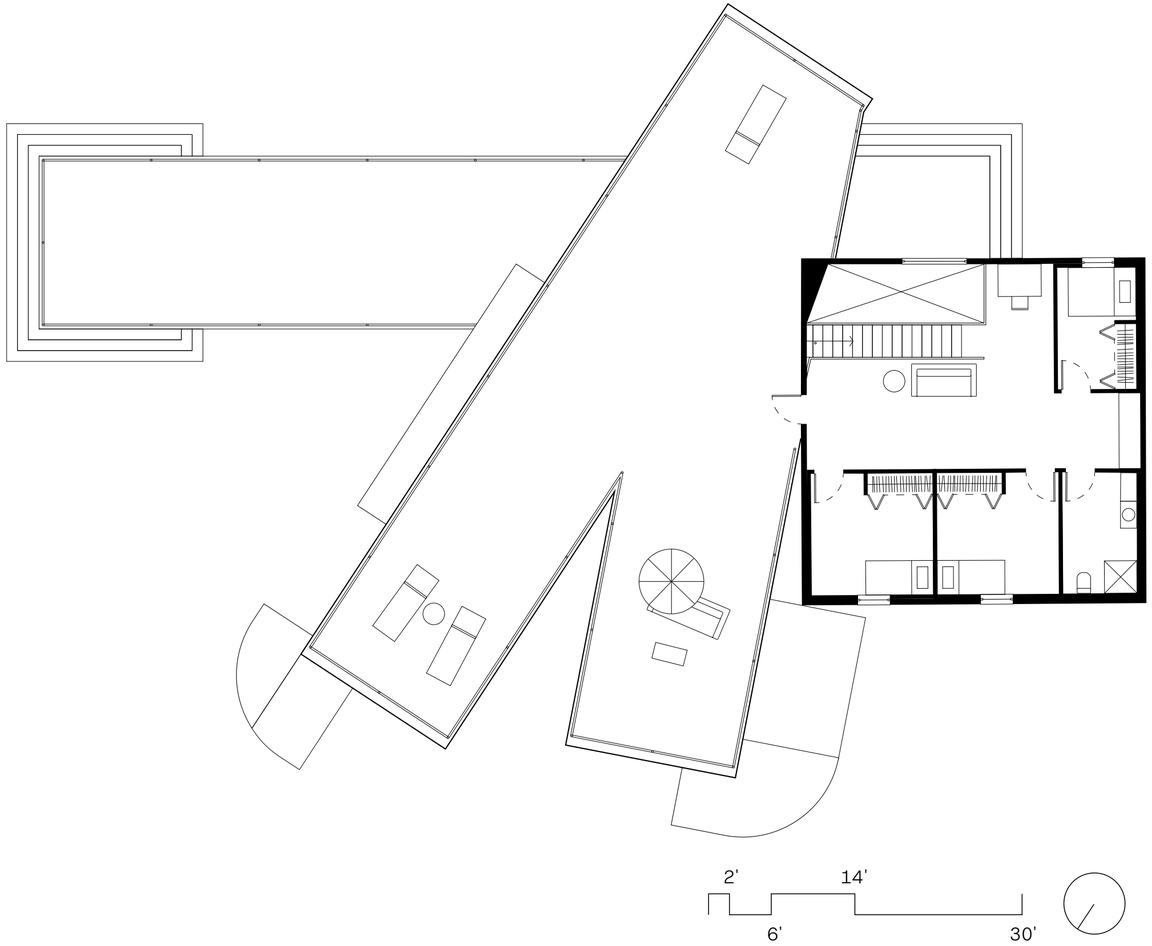
Now, with an interior, decks, porches, and other elements, the project starts to resemble a real building that could actually be constructed. This first iteration, while interesting, is not satisfactory for what I had in mind. As fun as it was gamboling around in Grasshopper, more worked needed to be done to get rid of the architectural vacillation.



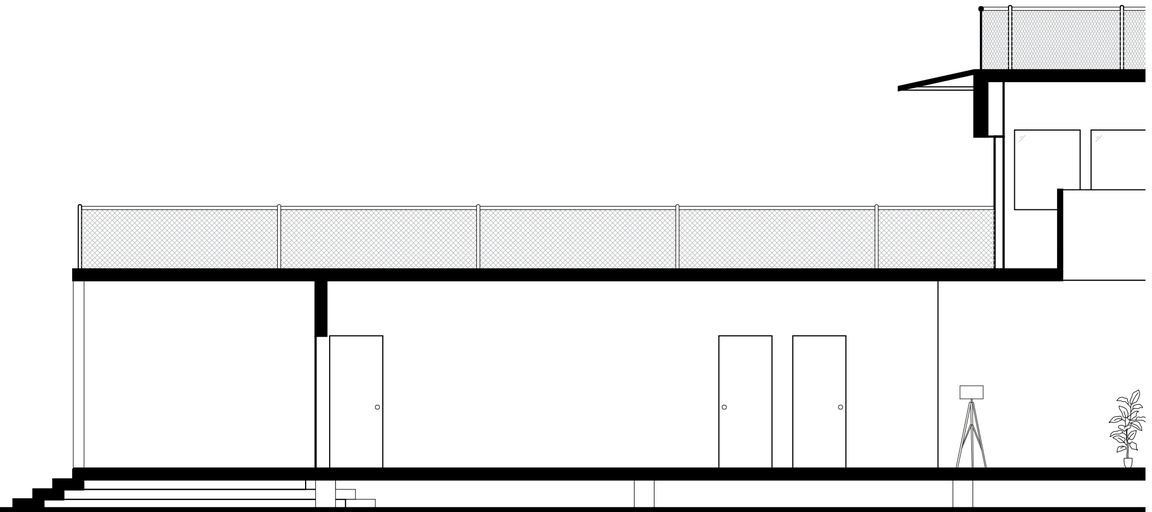
Ground Floor Plan

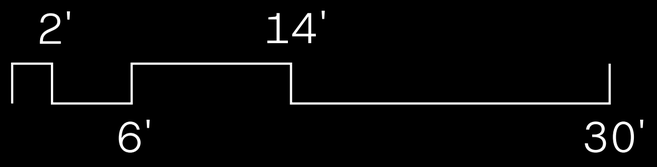


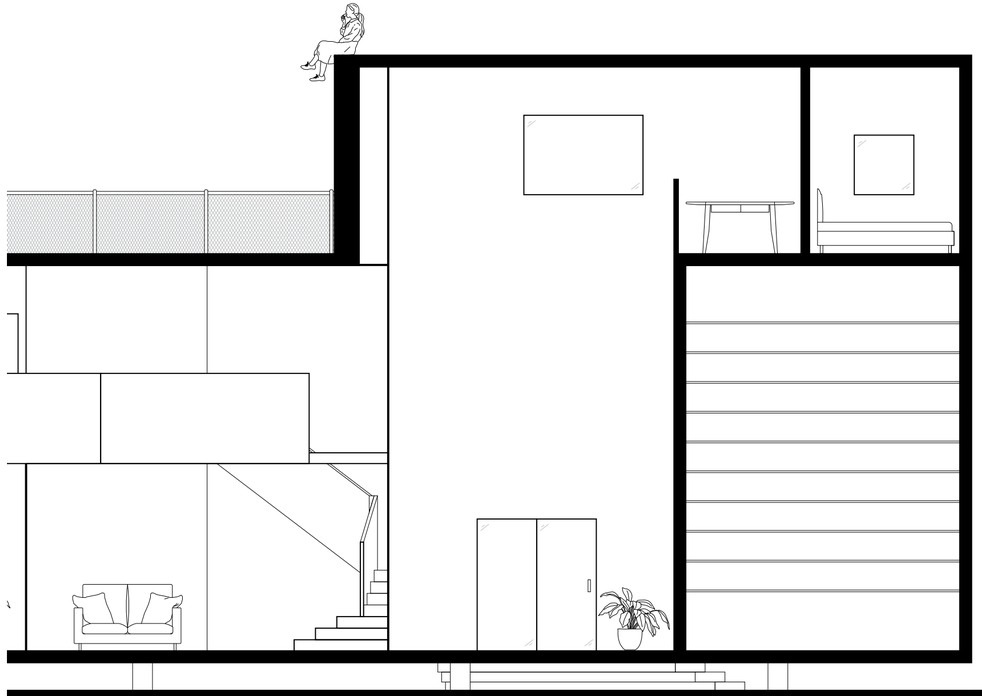
Second Floor Plan

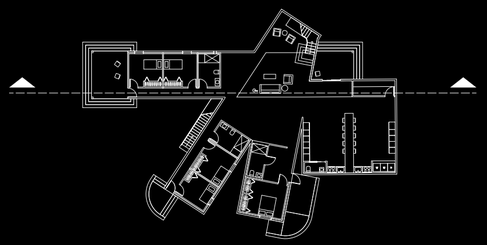


Third Floor Plan




2'
14'
6'
30'





3.

A Scintilla of Adroitness

The first iteration generated by the script provided the ground work and ideas for the final, "resolved" version of project. For me to be to satisfied, I had to make the script *more complicated and more difficult* to deal with (of course). I also had to make the project larger, with more units to worry about (you know how it is, right?). I had to draw a line somewhere, though, and did so literally as you will see in the plan drawings. The actual forms generated by the script go on for a while, but I focused on a specific area to resolve.

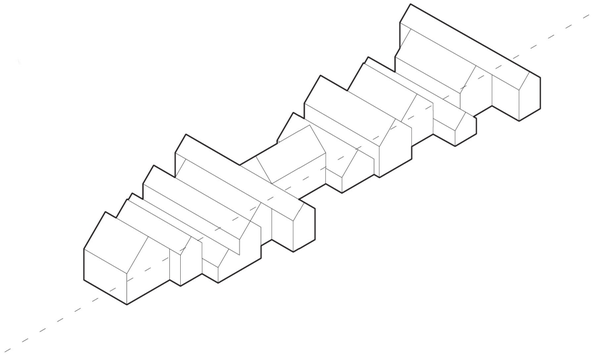
Rather than just have flat roofs that could easily be written off as they are, the script was modified to give all the forms gable roofs. Additionally, the script was made to lift some units off the ground at random, adding outdoor space that sweeps under the units, while maintaining the chain of housing.

Just for a little more fun and technological exploration, 3D printing was incorporated into the design process. For every unit that was lifted off the ground, an accompanying 3D printed wood resin structure was designed to support it. While the 3D printed structure is not scripted, it follows rules like the rest of the project. Quite simply, the walls are made of circles that have their inflection points located at structural stress points.

There are many other small, less significant rules added throughout the remainder of the project, unrelated to the script, but I think it would be more fun if I didn't point them out to you.

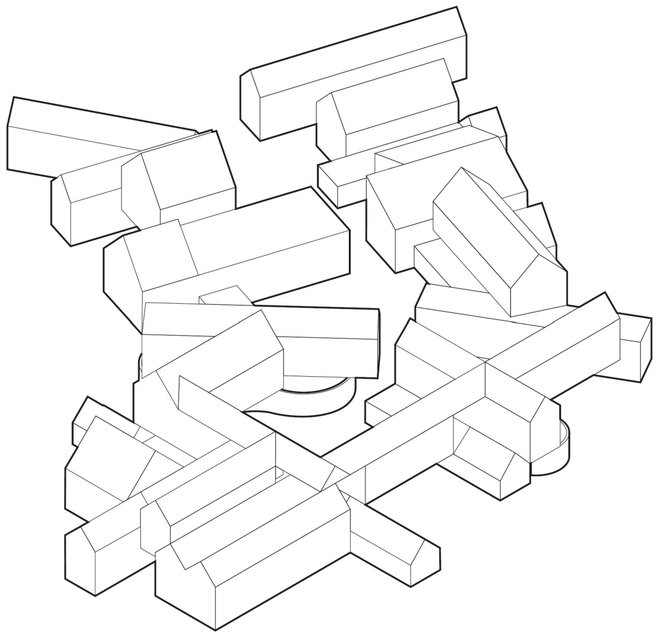
Step 3-ish:

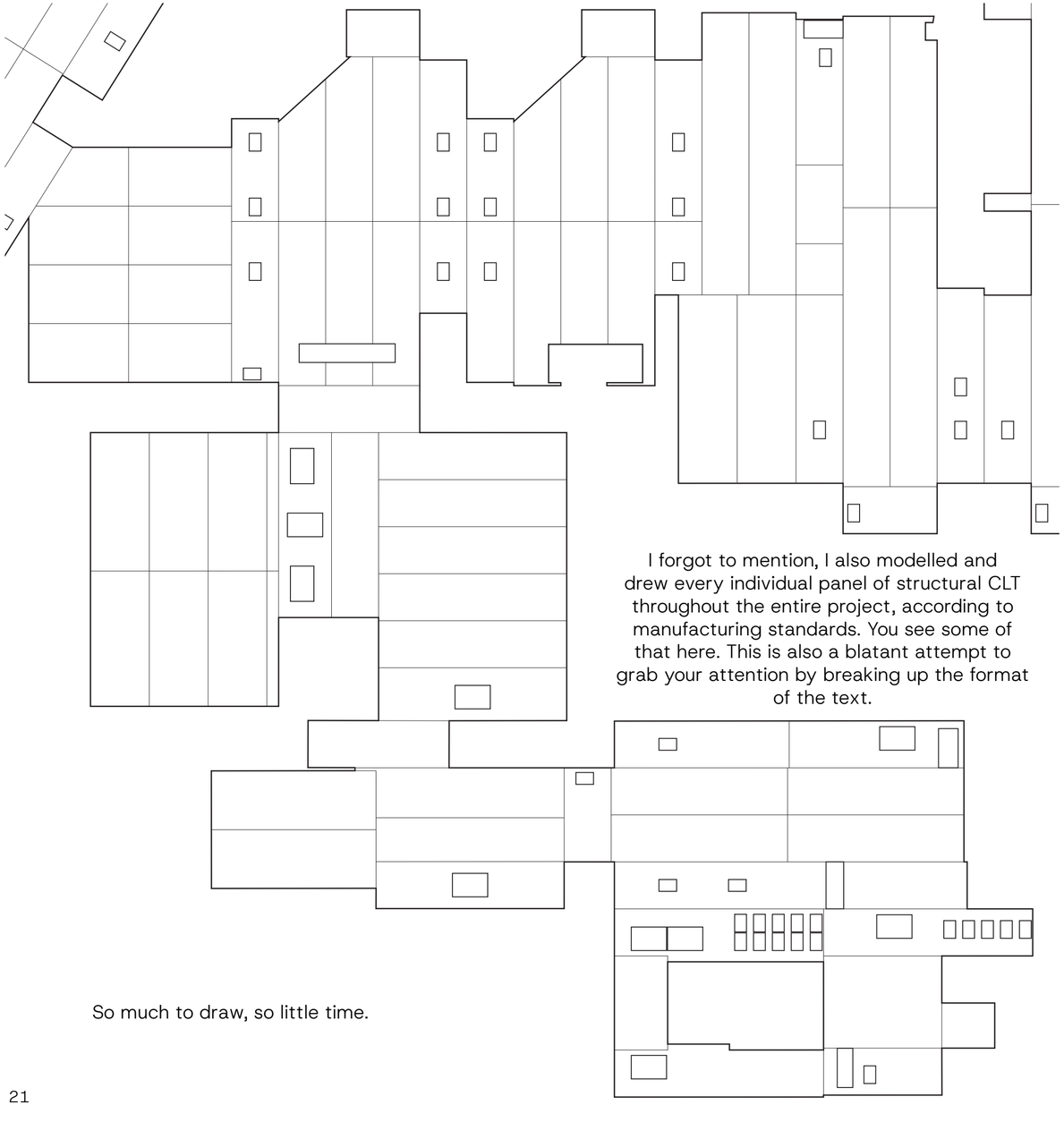
block forms are given a gable roof



Step 4-ish:

some random blocks are lifted off the ground and details and personal touches are added.





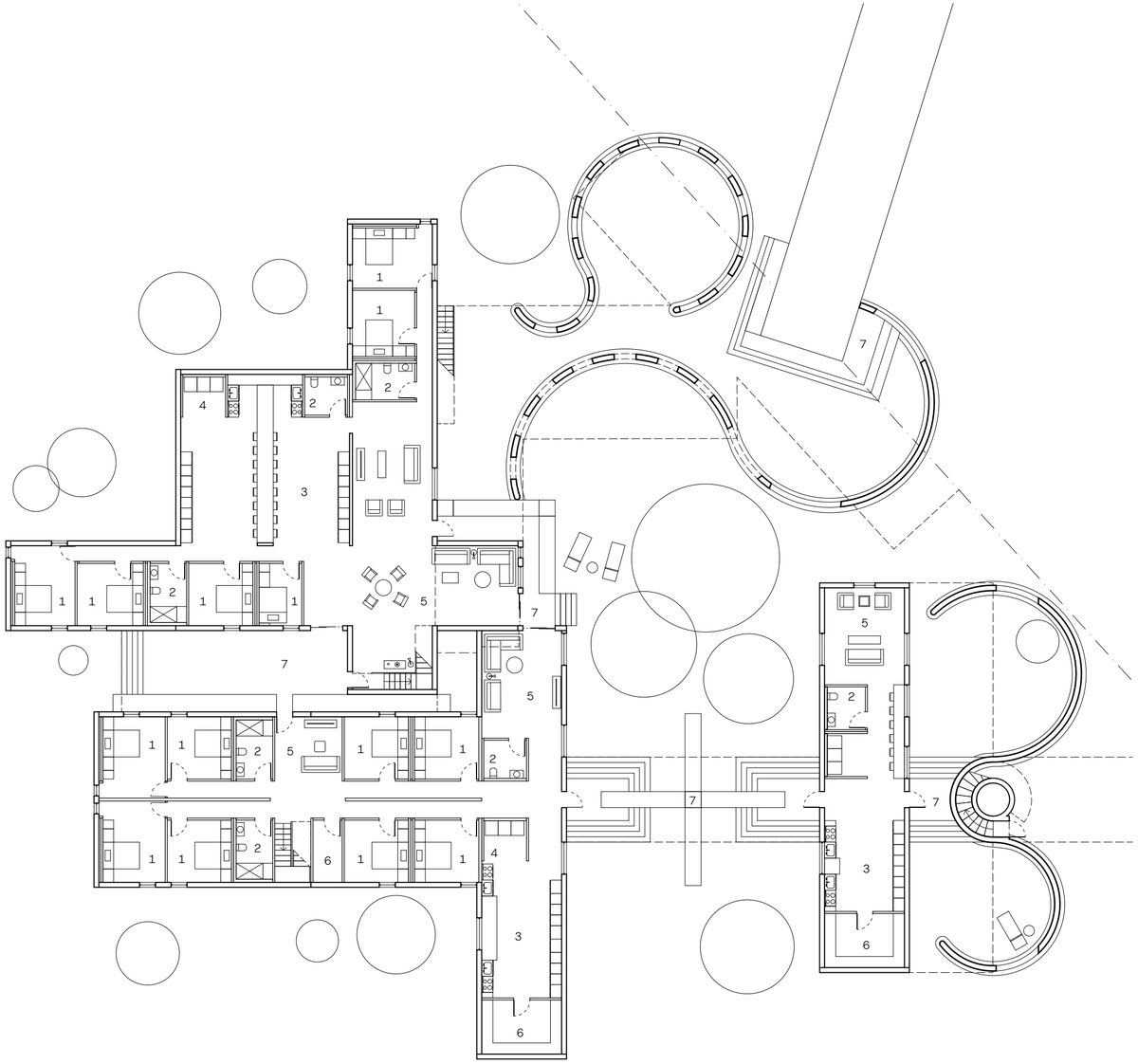
I forgot to mention, I also modelled and drew every individual panel of structural CLT throughout the entire project, according to manufacturing standards. You see some of that here. This is also a blatant attempt to grab your attention by breaking up the format of the text.

So much to draw, so little time.

The panels, as you see, are often repeated. Thanks to parametric magic, everything can easily be split up into repeatable, standard pieces. This includes both the exterior CLT skeleton of the building as well as the interior, which I created a mini-module for.

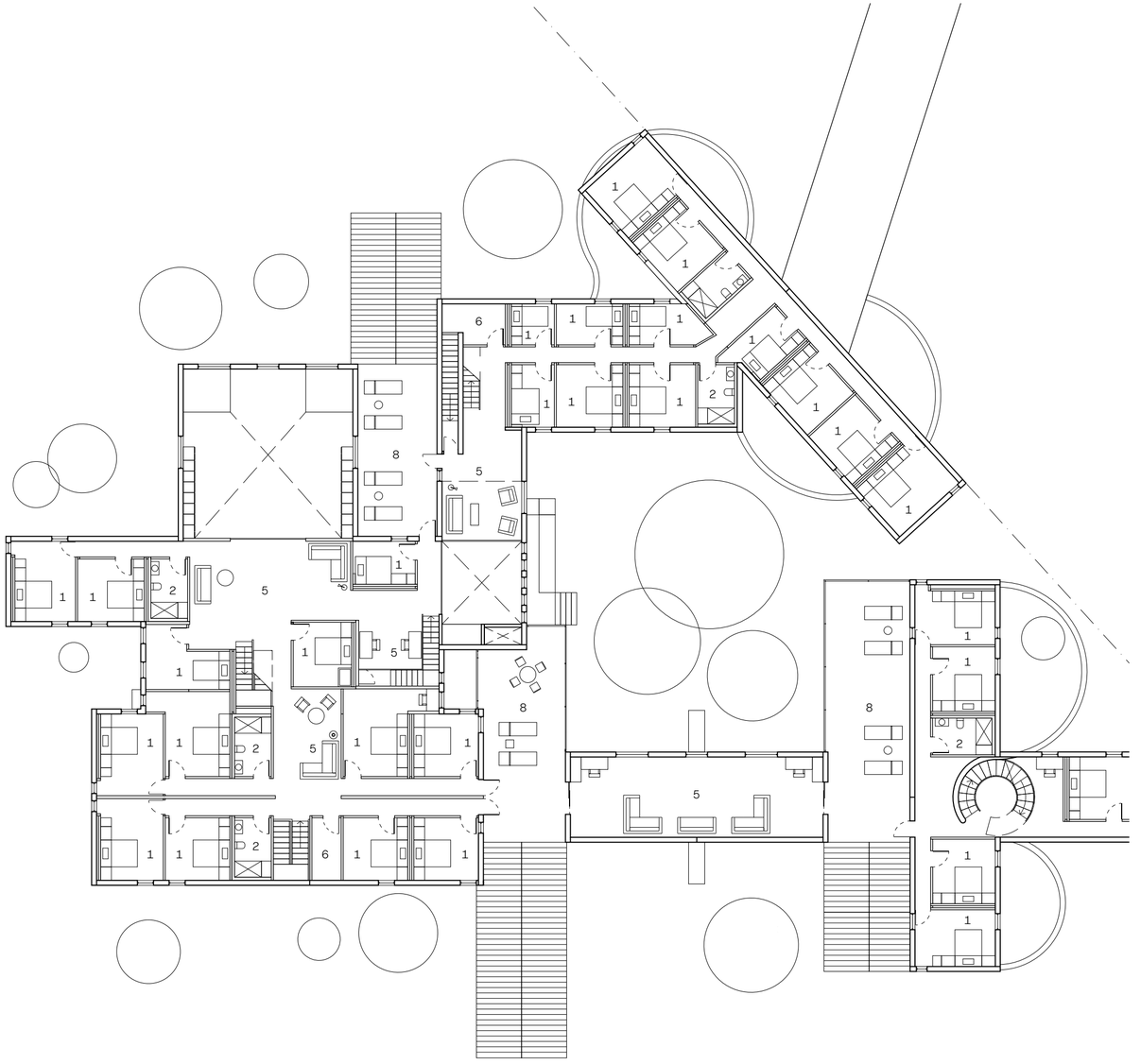
There are many instances in which the panels are just a tad bit off in the case of intersecting units and whatnot. I will blame it on the randomness given by the script. For a first attempt at designing housing, and scripts, and modules, I would say the occasional error is fine. Engineers have a margin of error, so I get one too.

And now, architecture...



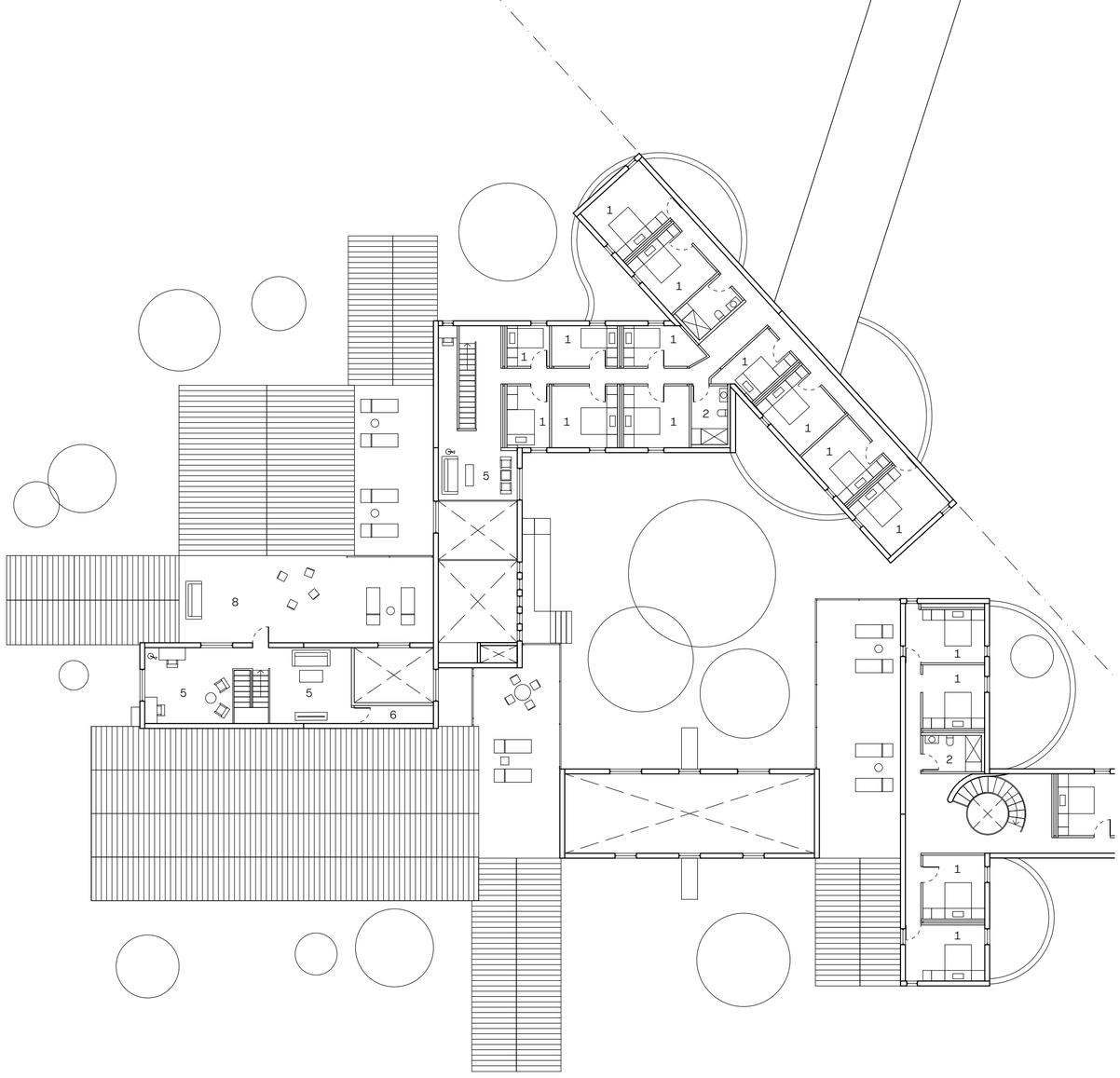
Ground Floor Plan

1 - Bedroom
2 - Bathroom
3 - Community Kitchen
4 - Community Laundry
5 - Community Living Space
6 - Community Storage Space
7 - Porch
8 - Rooftop Deck



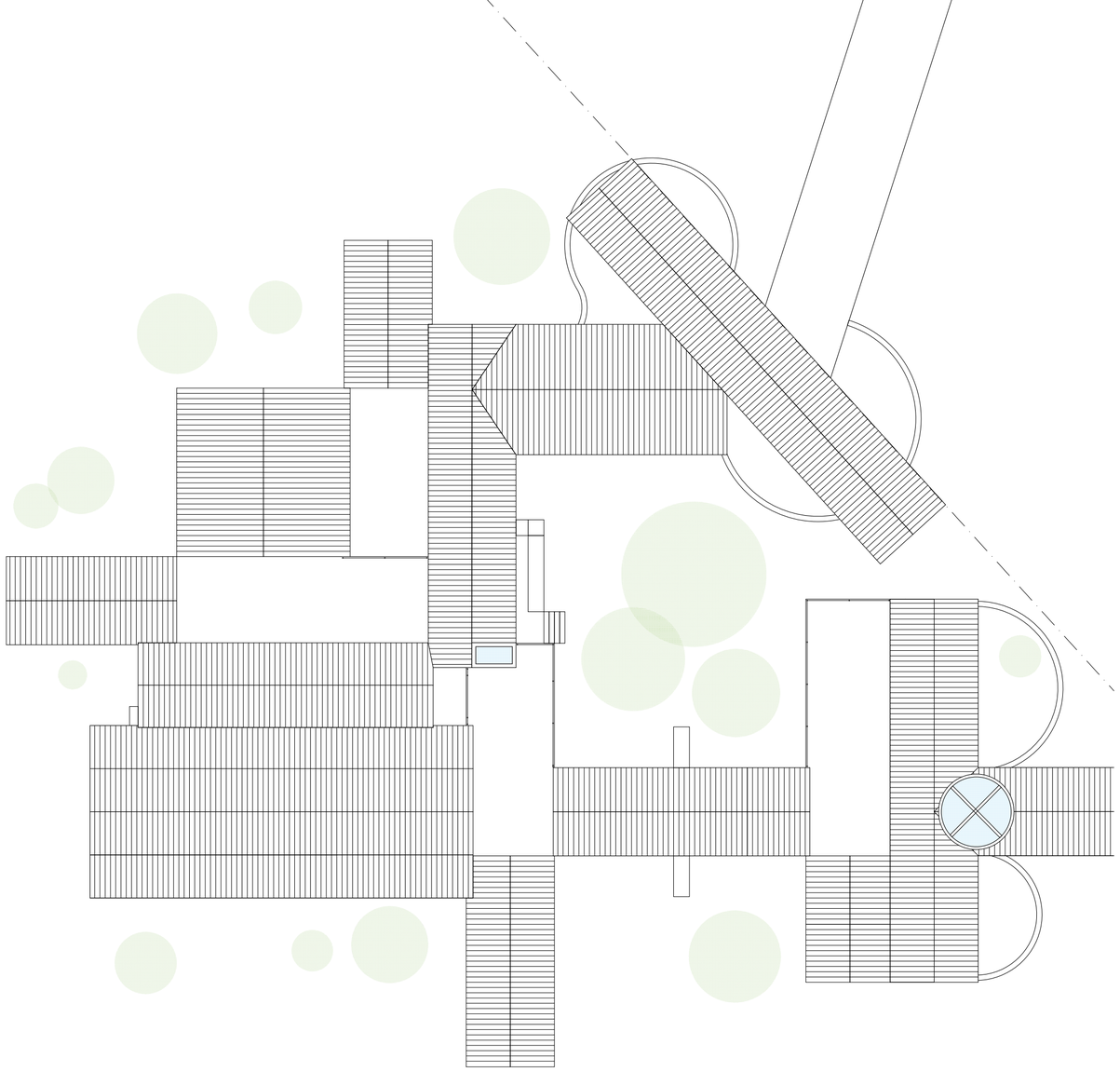
Second Floor Plan

4′ 8′ 16′ 32′



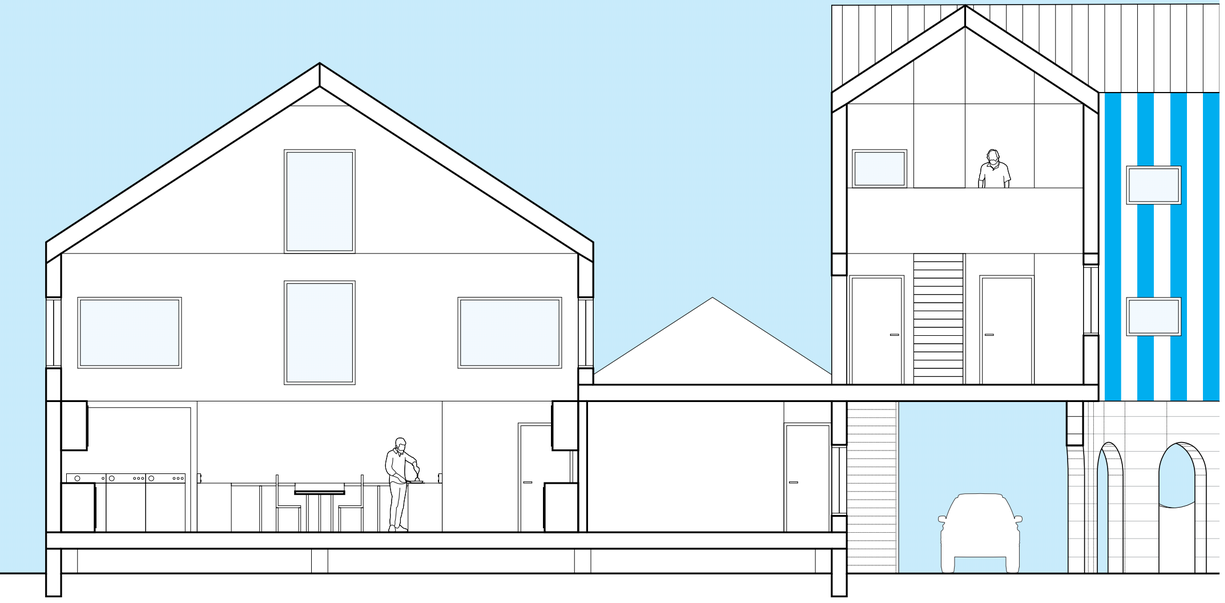
Third Floor Plan

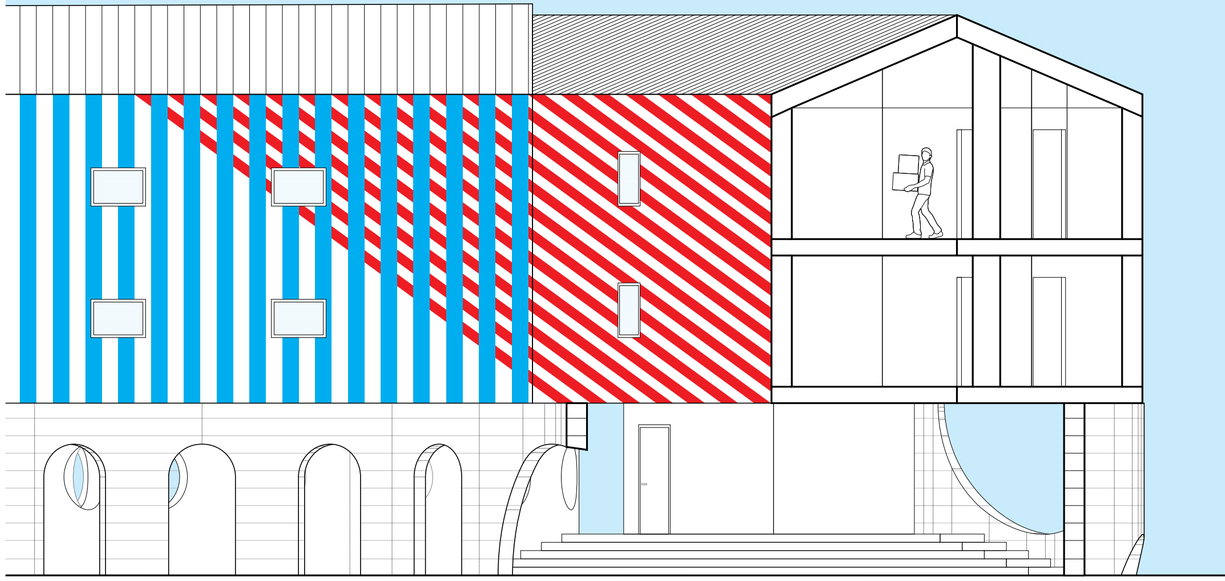
1 - Bedroom
2 - Bathroom
5 - Community Living Space
6 - Community Storage Space
8 - Rooftop Deck

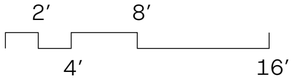


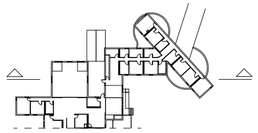
Roof Plan

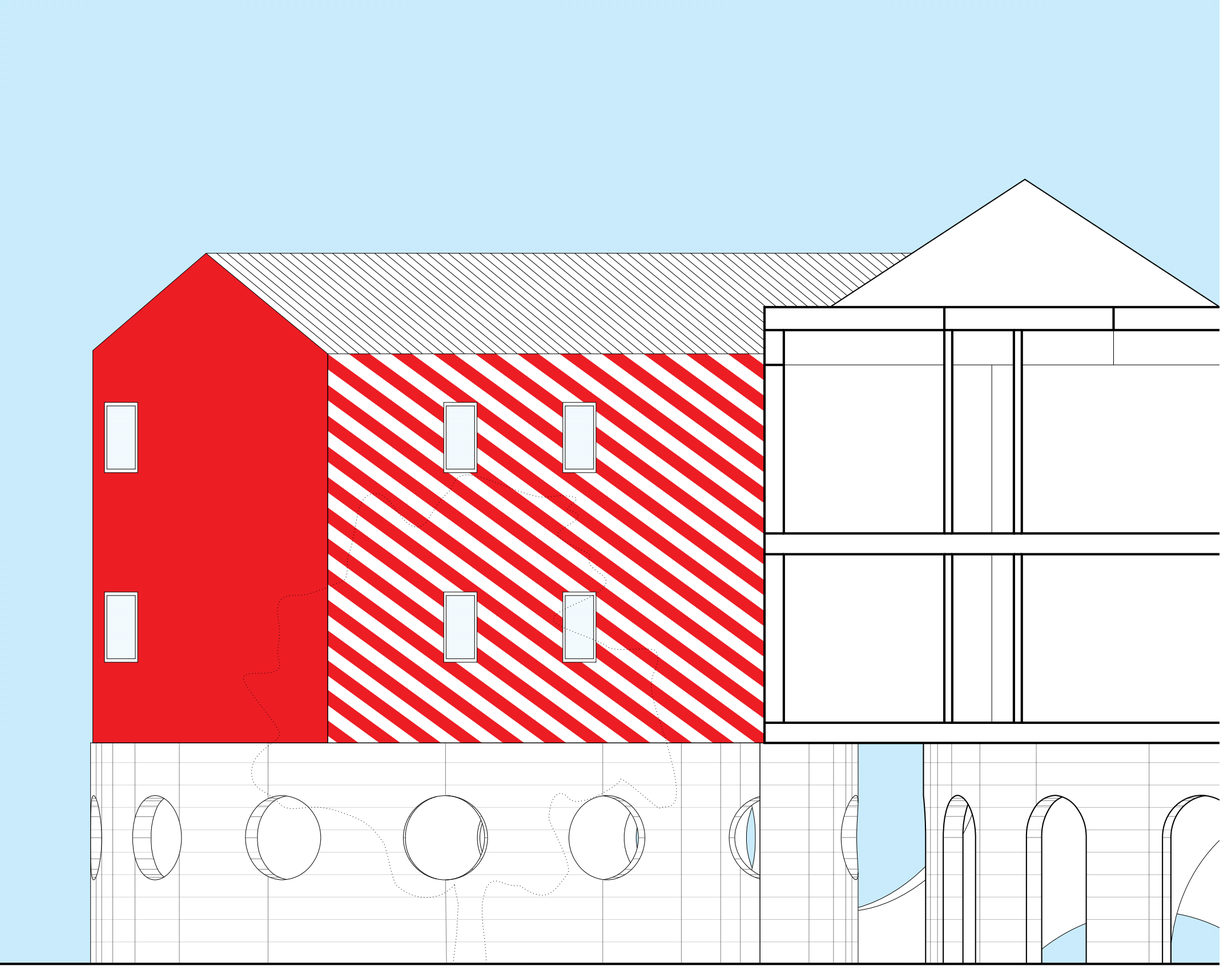
4′ 8′ 16′ 32′

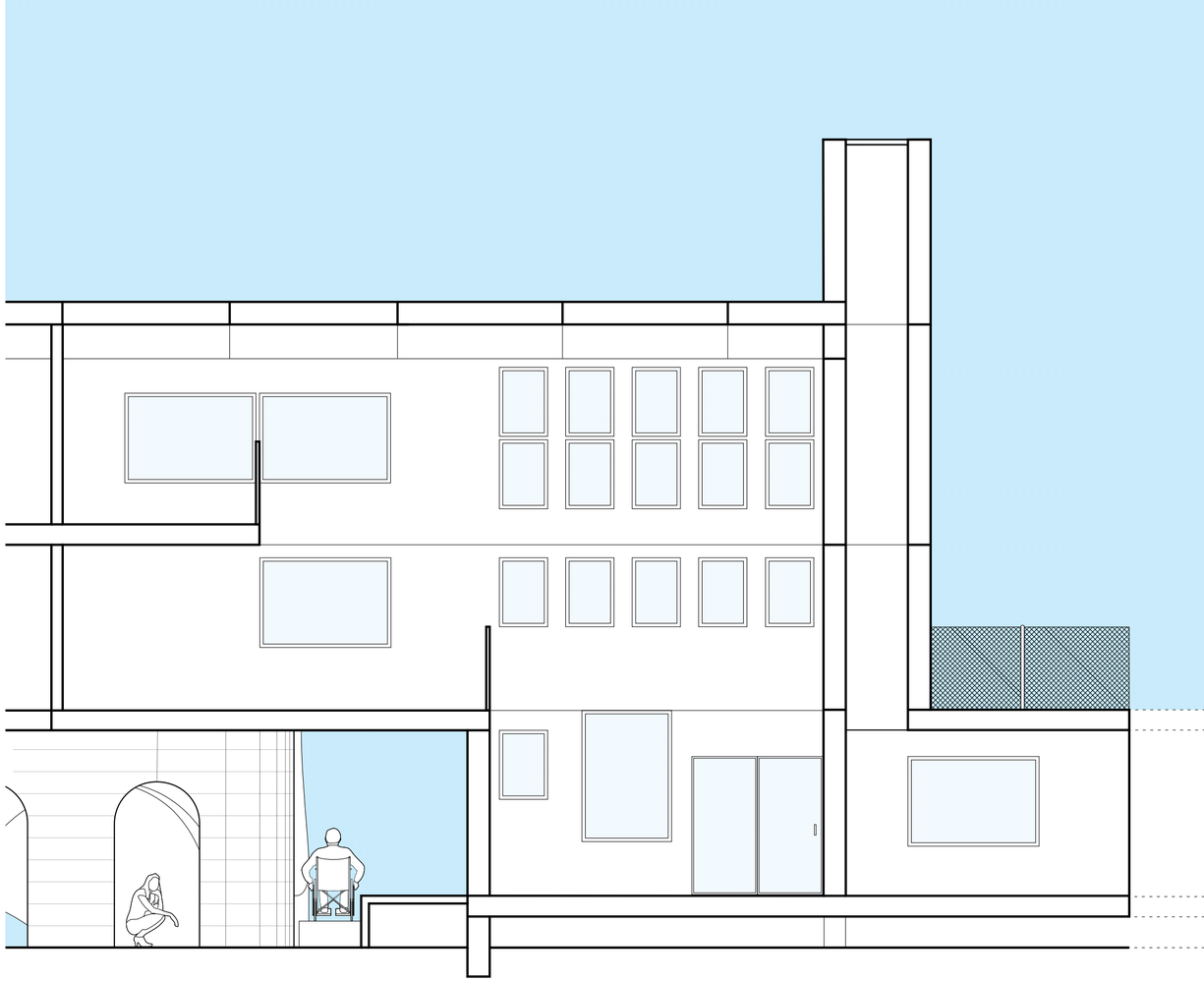


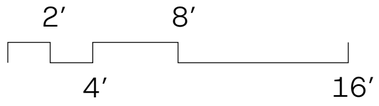


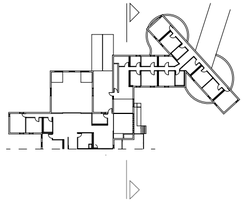

2′
8′
4′
16′

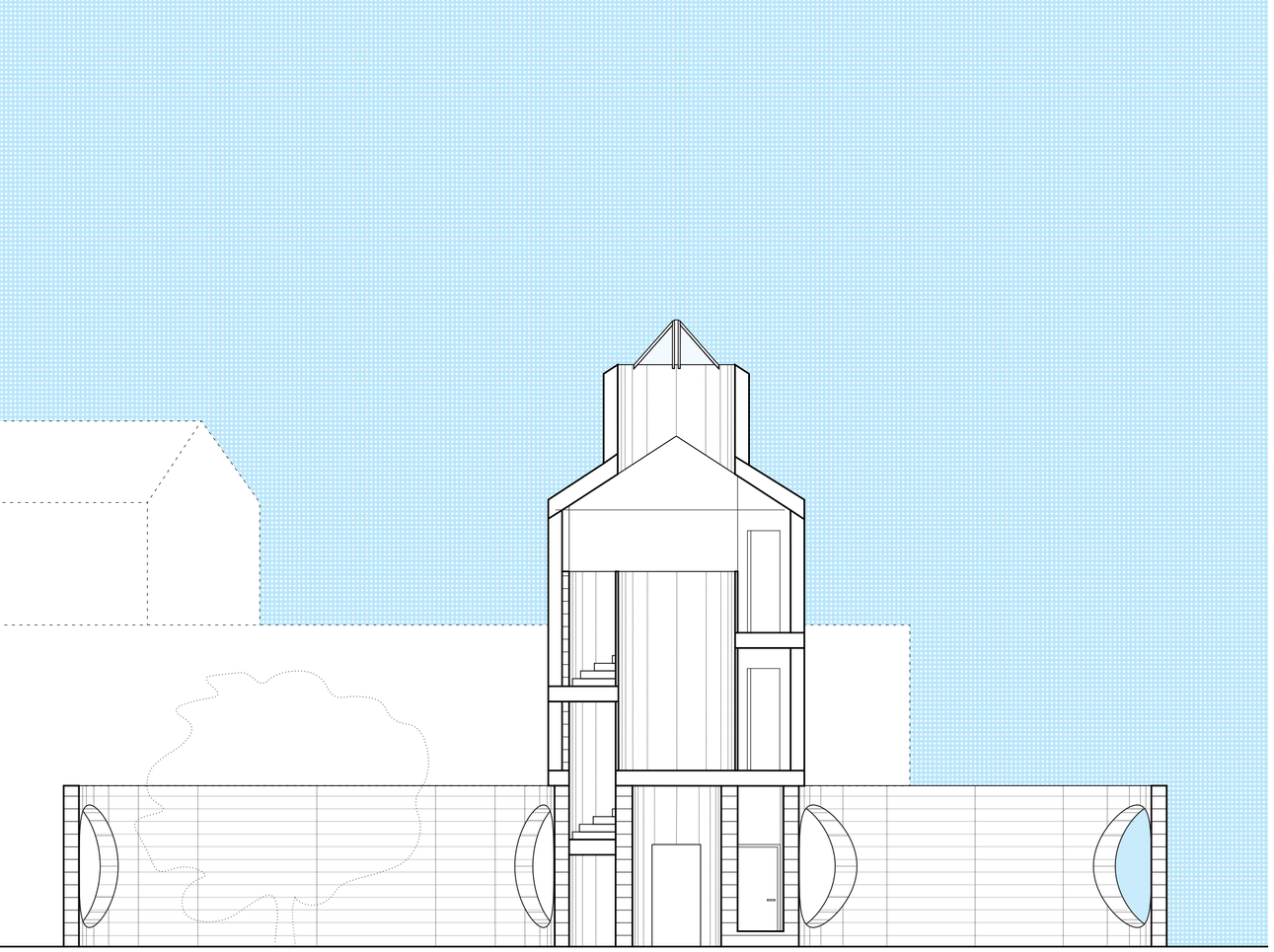


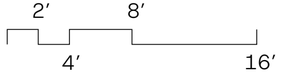


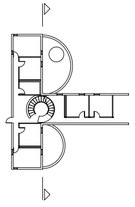



2′
8′
4′
16′



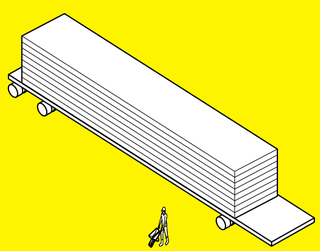


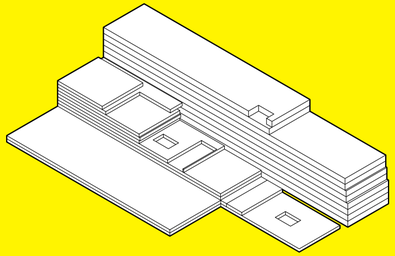


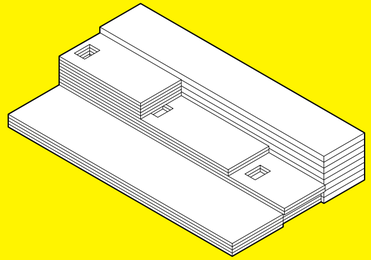


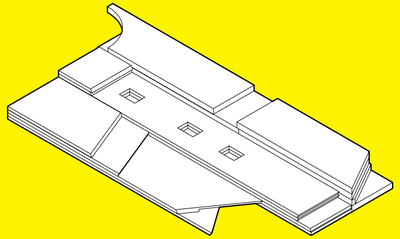
Even with all of the different elements and strategies and *chaos* used to create the project, it ended up being *fairly* comprehensible (not without lost sleep, mind you). Despite the rigid, standard, and simple framework that makes up the project, there was a lot of opportunity for architectural intervention and experimentation. Juggling scipts, CLT manufactring standards, 3D printing, and personal design authorships is not easy, it turns out. It is possible, though, to create a system of your own from scratch, even if you are clueless of what to do at the start (or end).

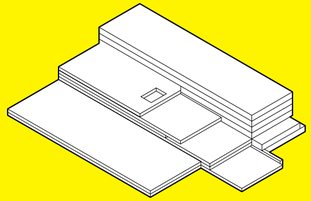
With the big picture of the project resolved, there was the matter of details, interior and exterior, to resolve. Obviously, with the scale of the project, there was only so much I could detail out, being an individual, gormless grad student and all. The details focused on elements that are most essential and most repeatable, so structure, envelope, and walls, mostly. If a detail is included in this book, it is repeated a lot throughout the entirety of the building complex. Additionally, if a detail is not called out in the little catalog I made, it means it is called out elsewhere. I haven't quite gotten to the level of creating a script for the details, but maybe one day. And now, the place where God resides, the details...

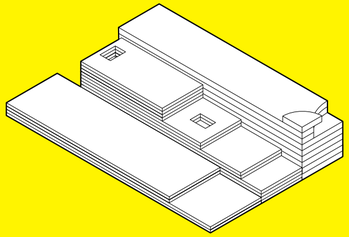


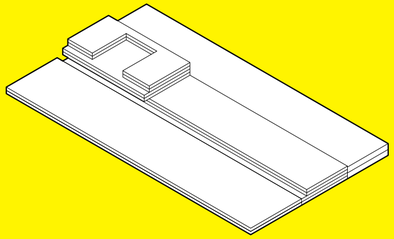


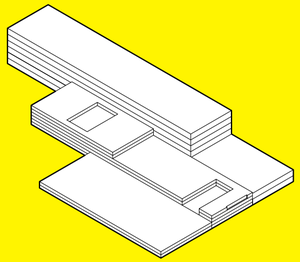


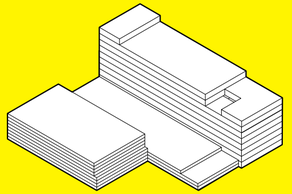


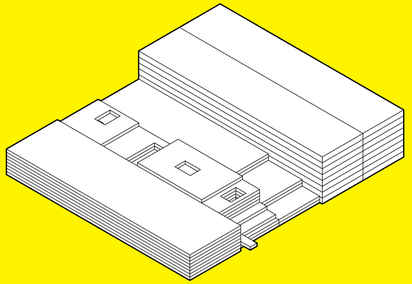


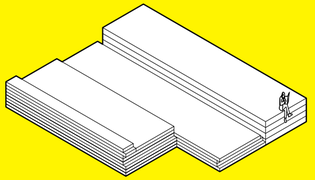


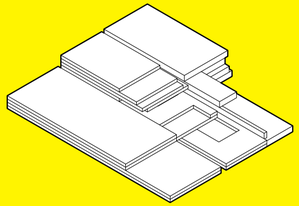


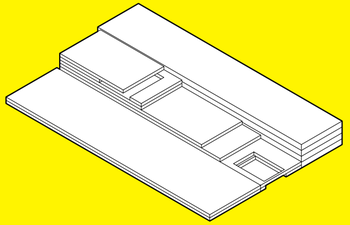


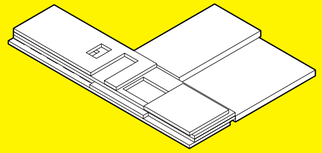


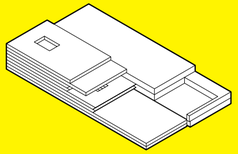


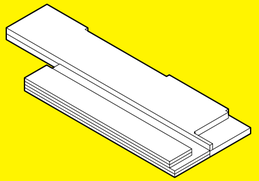


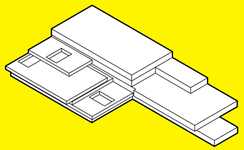


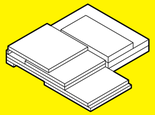












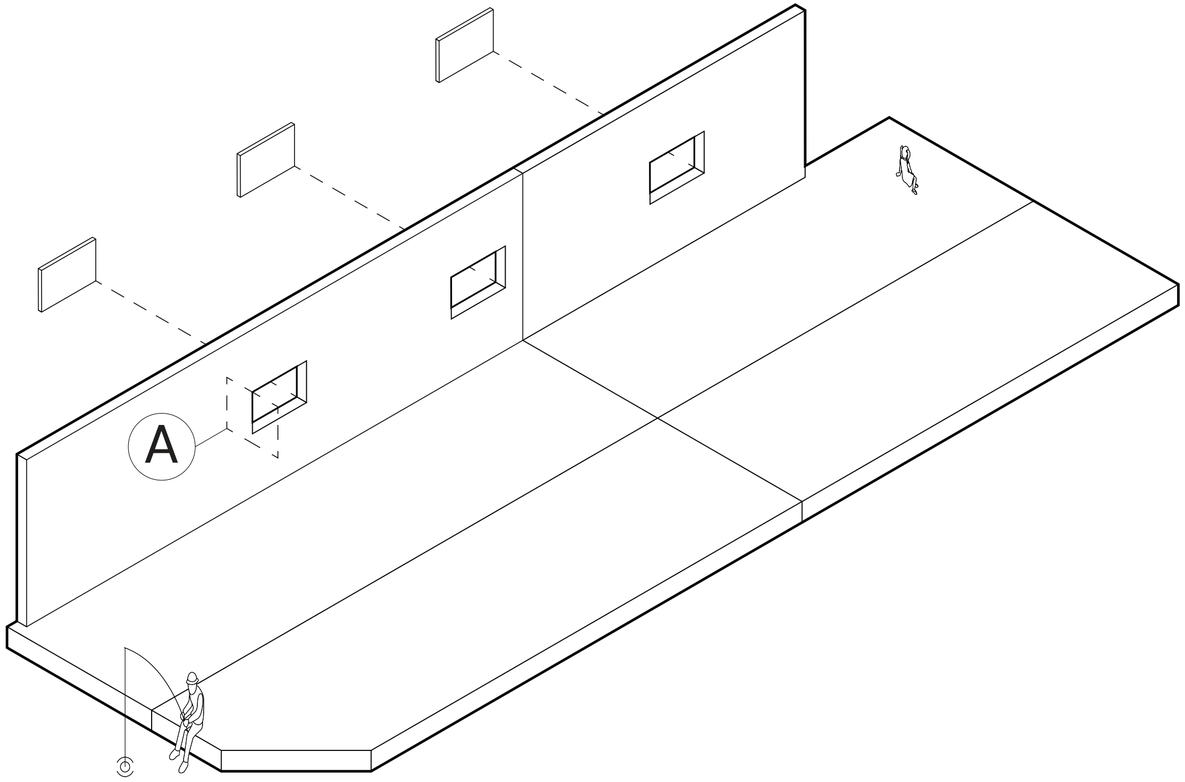
4.

Tectonic Aplomb

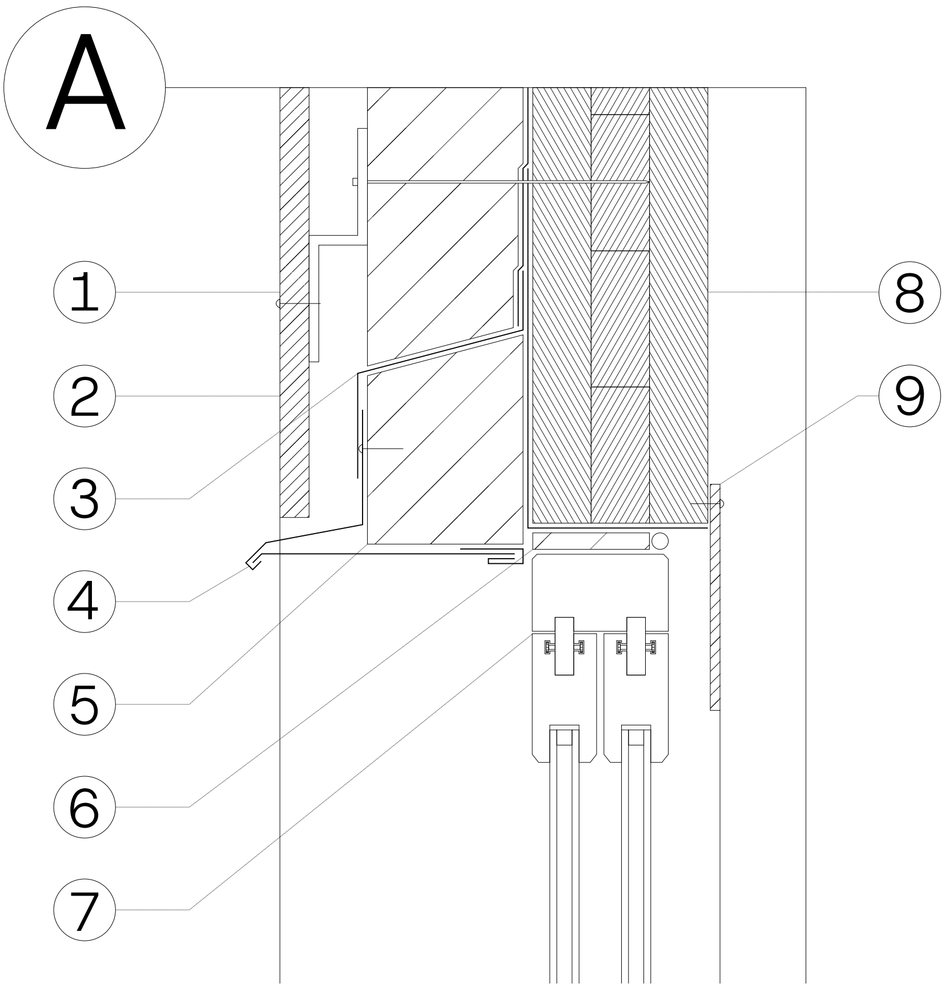
Keeping with the idea of repitition, standardization, and modularity, all of the details documented are intended to be repeated and reused all over the place. Thanks to the wonders of CLT and to the relatively light weight of this project's construction, much of the important details are fairly straightforward. In fact, many of them could be constructed by unskilled people; for the interior details, this was intentional.

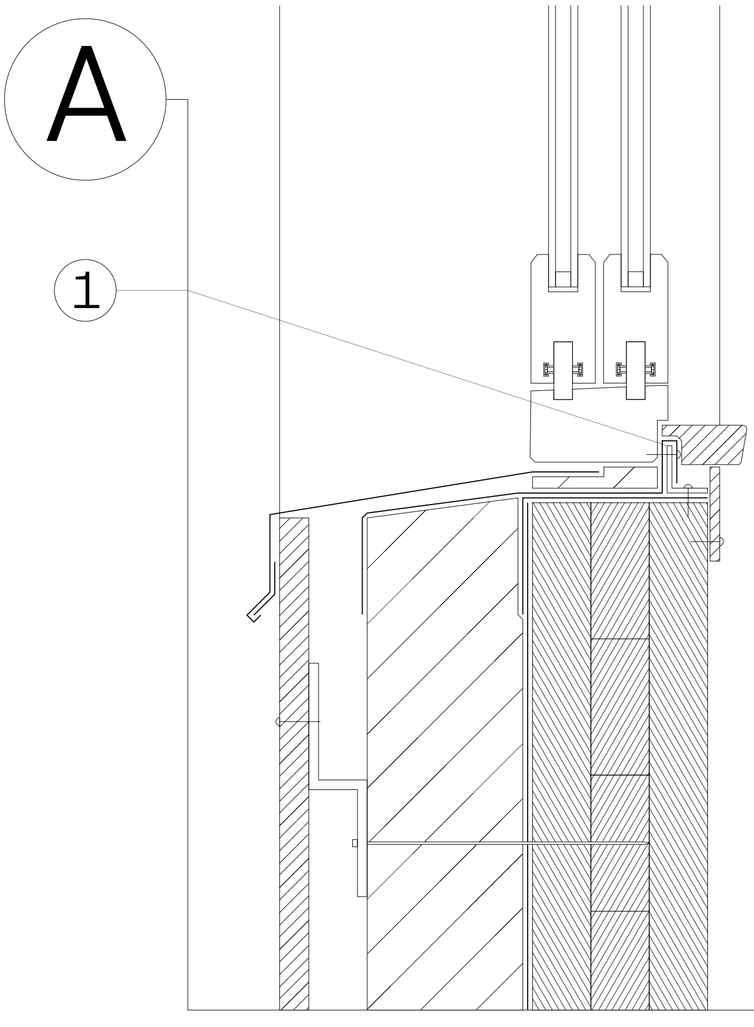
The exterior envelope details and foundation are complex and require people who know what they are doing, but for much of the interior, there is a *degree of flexibility*. A simple module was developed for the bathroom and bedrooms that is repeatable and has many slight variations to it. As the whole building was built out parametrically, the interior module fits quite comfortably within any interior space of the project. The module consists of 8′ long, 3-ply CLT panels and square, 3-ply CLT columns to finish out walls, provide space for MEP, and provide structural rigidity. Since all of the connections on the interior are either just nails or brackets, *they can be undone*. The floor is a bit more annoying, but walls can be removed and moved around to suit the space as needed (with a little physical labor and teamwork).

This contributes to the idea that housing should be flexible and adaptable; apartments should be able to turn into living rooms and offices and vice reversa. This is not the most efficient means of organizing housing, but it starts to give power to residents to modify their environment.

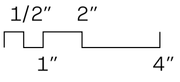


1. Plywood cladding
2. Air barrier and cladding bracket
3. Window flexible flashing membrane
4. Window head flashing and closure
5. 4" Rigid insulation
6. WRB sealant over backer rod
7. 2-Pane sliding window system
8. 3-Ply CLT wall panel
9. Plywood sheathing





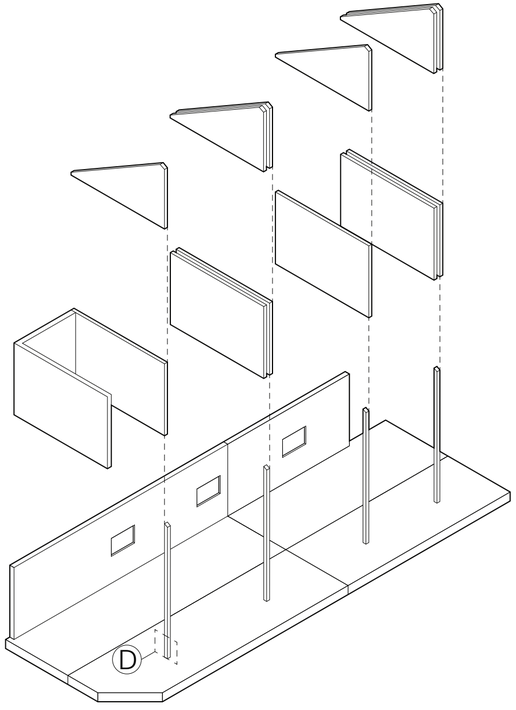
1. Air barrier and WRB sealant between window and metal back dam angle

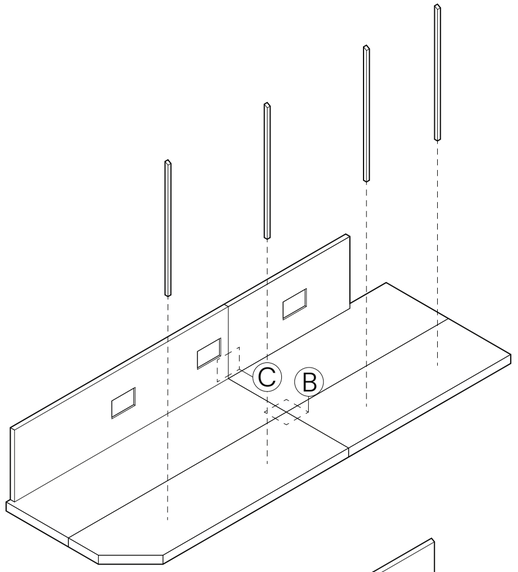


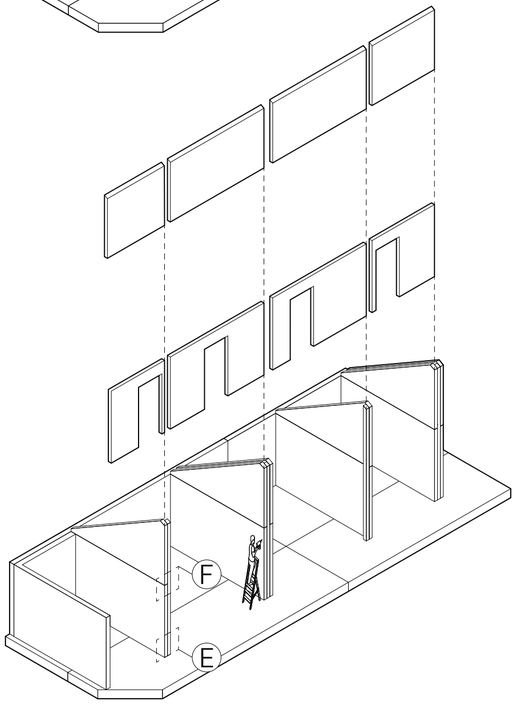
With a little time and aplomb, the module allows for easy integration and deintegration of bedrooms. A bedroom today can become a yoga studio tomorrow. A livingroom yesterday can become 3 dorms today.

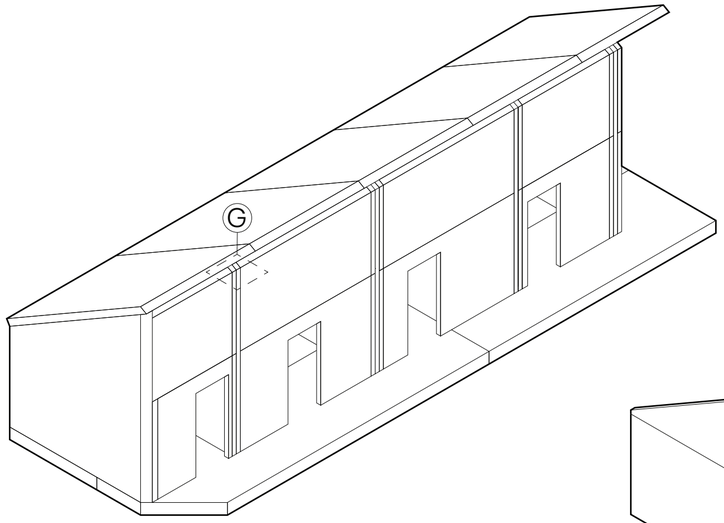
With a parametric script, a module, and enough free time, you can make architecture

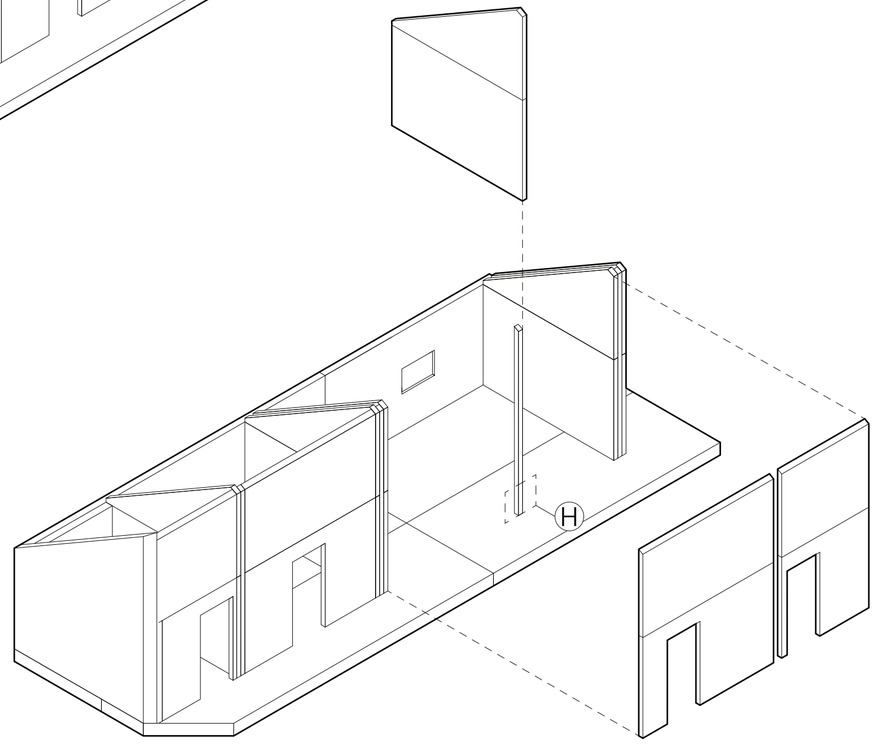
ad darn near infitum.

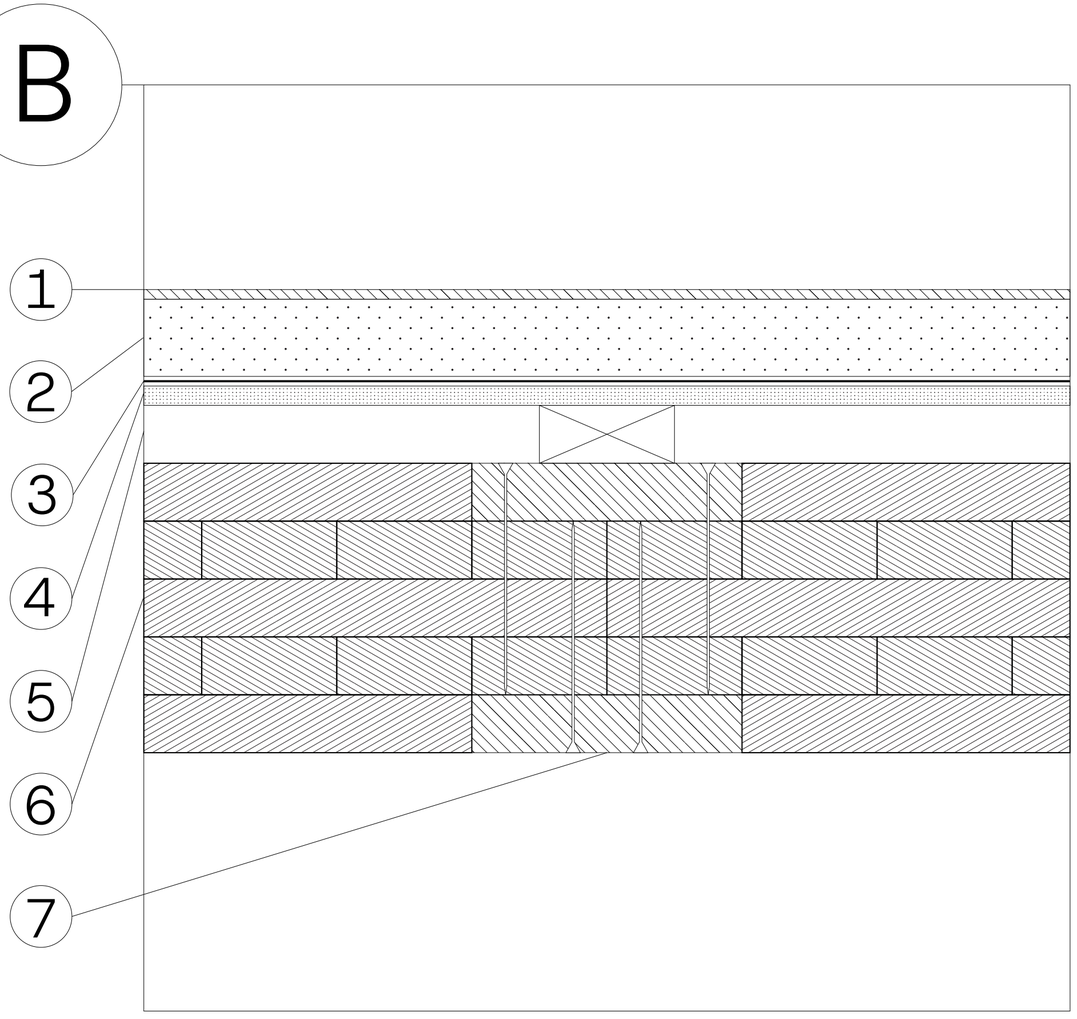












1. Vinyl flooring

2. 2" Concrete screed

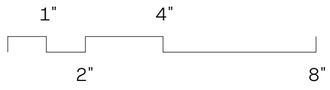
3. WRB Membrane

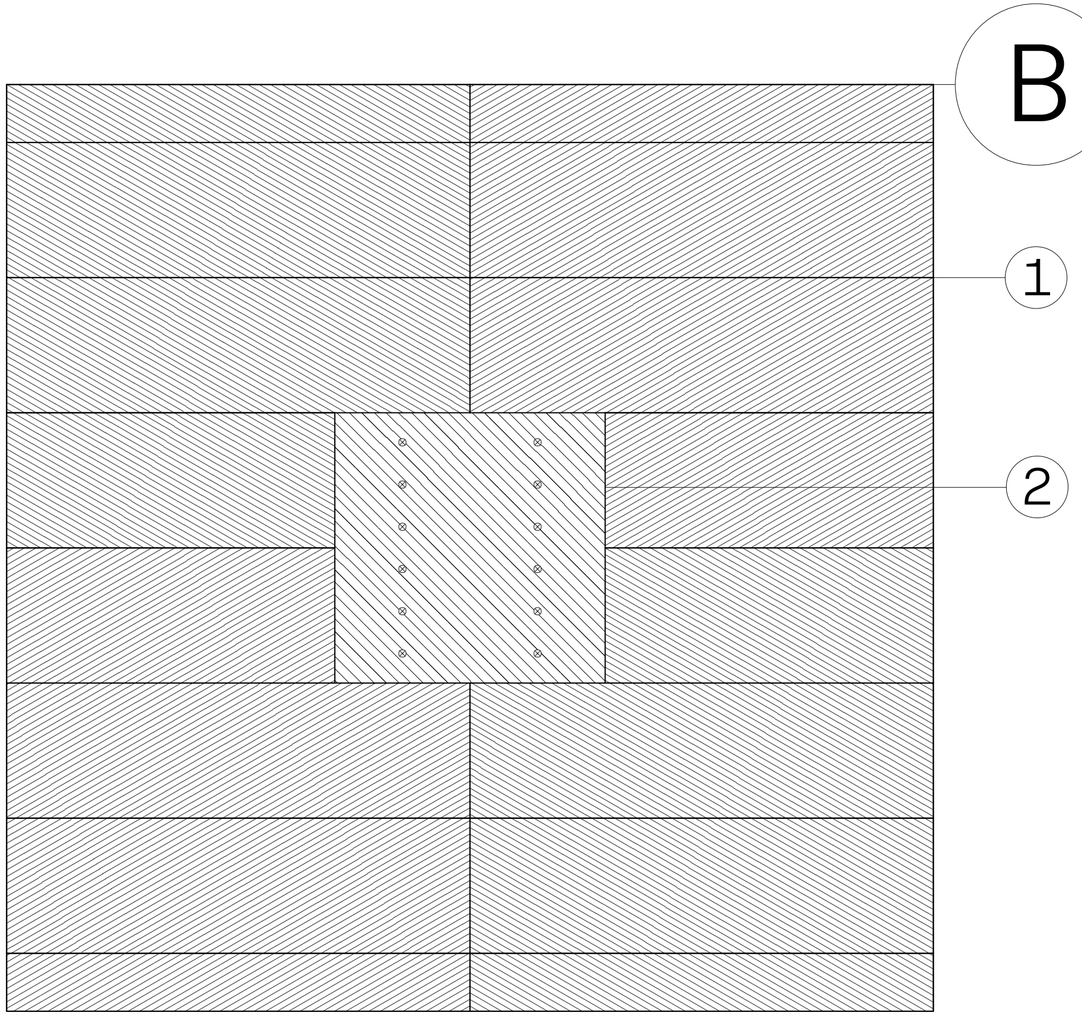
4. Acoustic paneling

5. 2x4 and air cavity

6. 5-ply CLT floor panel

7. SCL Spline with self-tapping screws

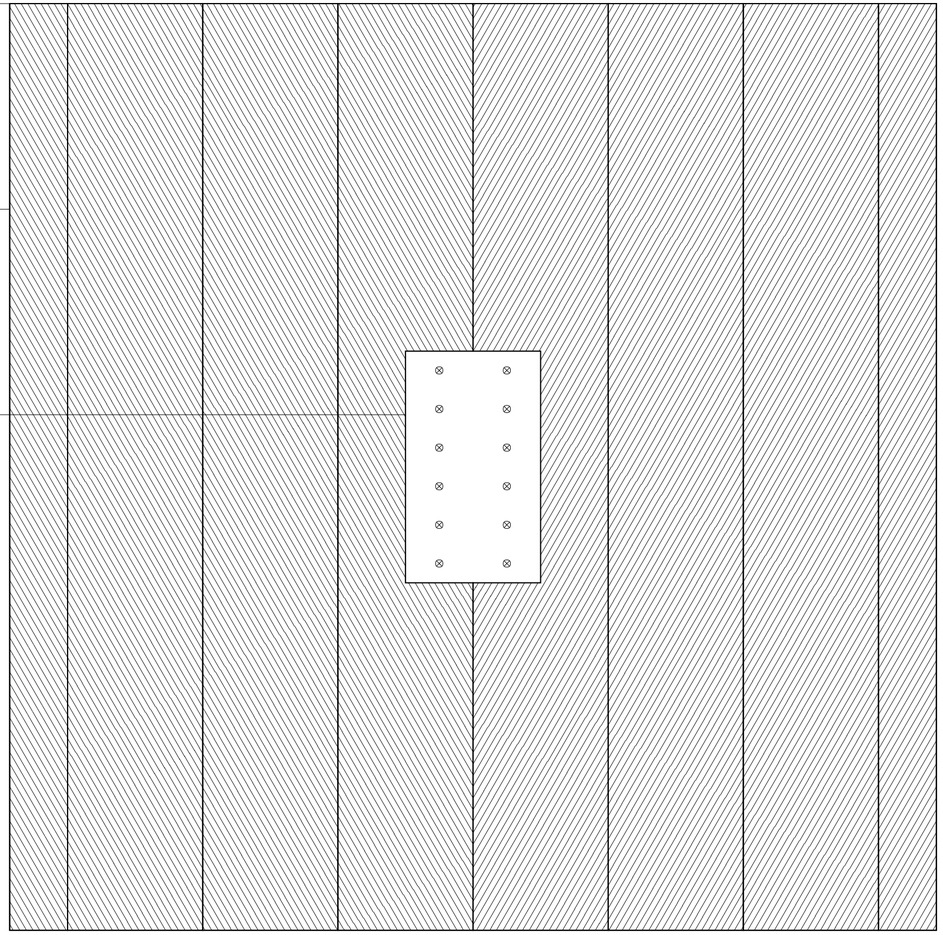




1. 5-Ply CLT floor panels

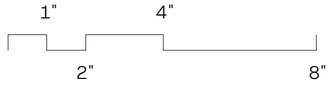
2. Structural composite lumber spline with self-tapping screws

C



1. 3-Ply CLT wall panels

2. Steel bracket with self-tapping screws



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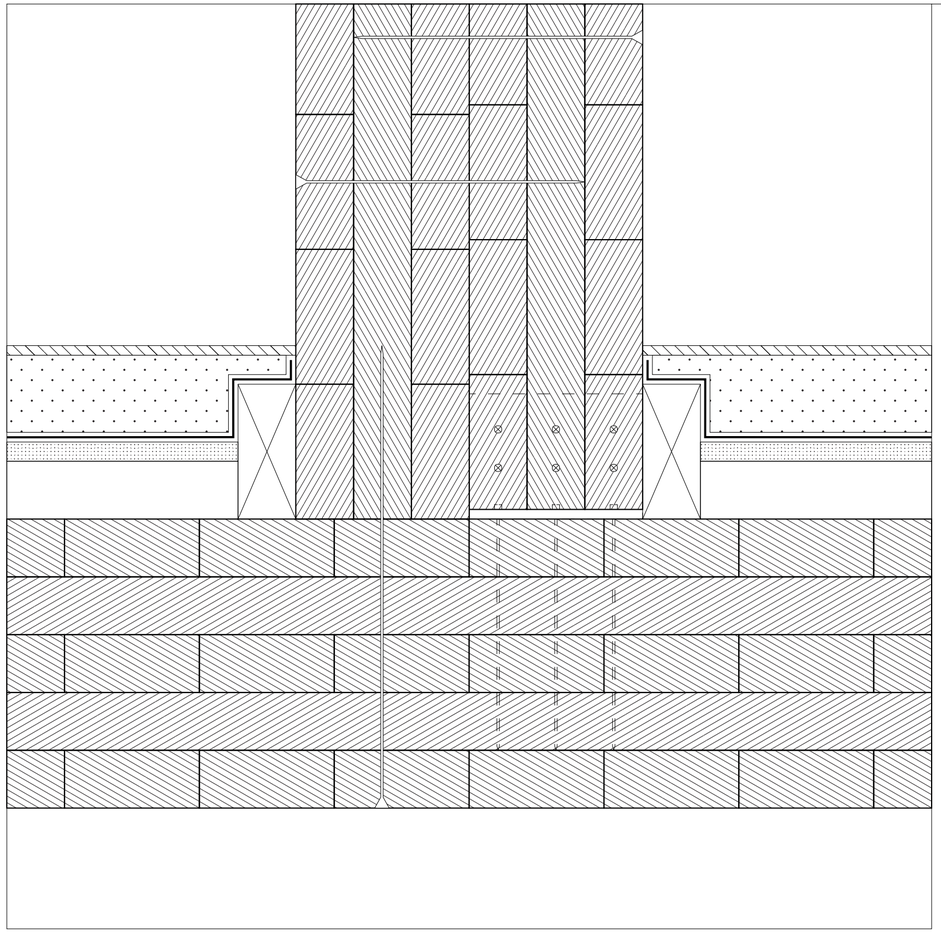

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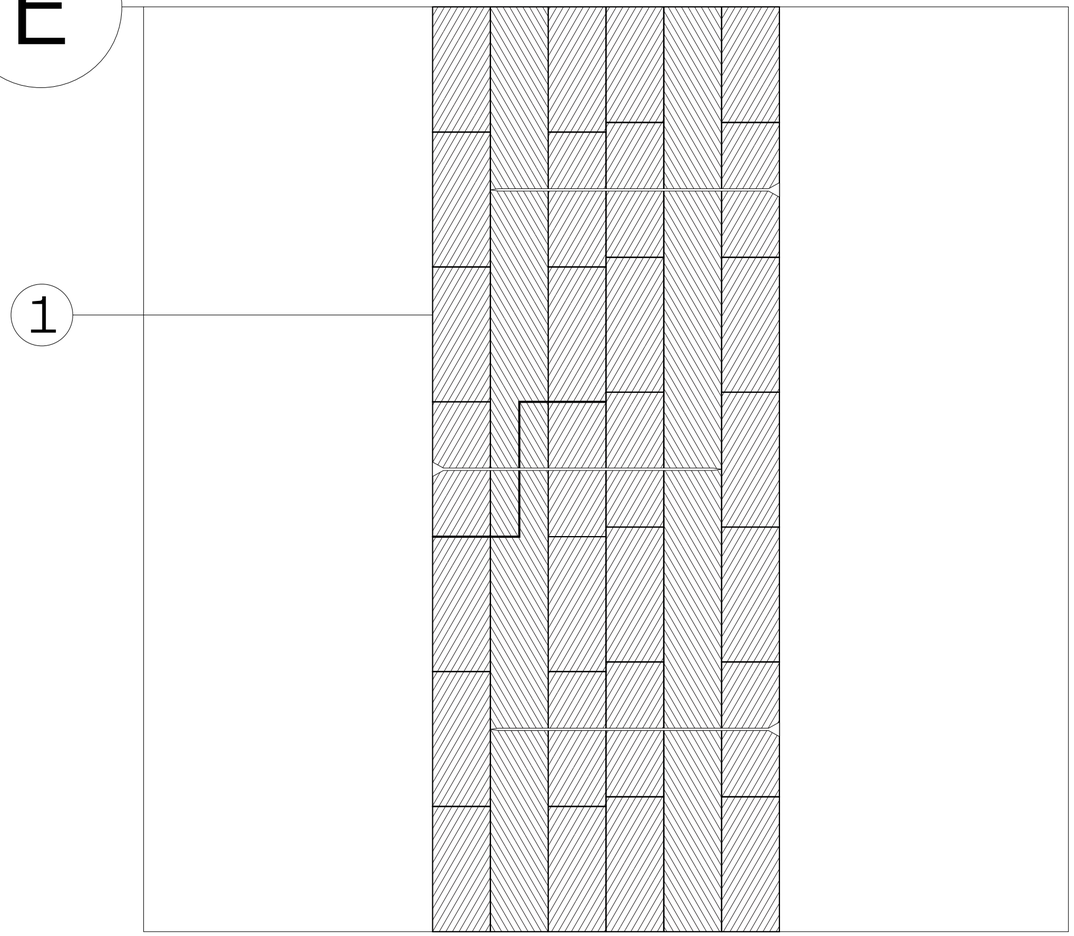
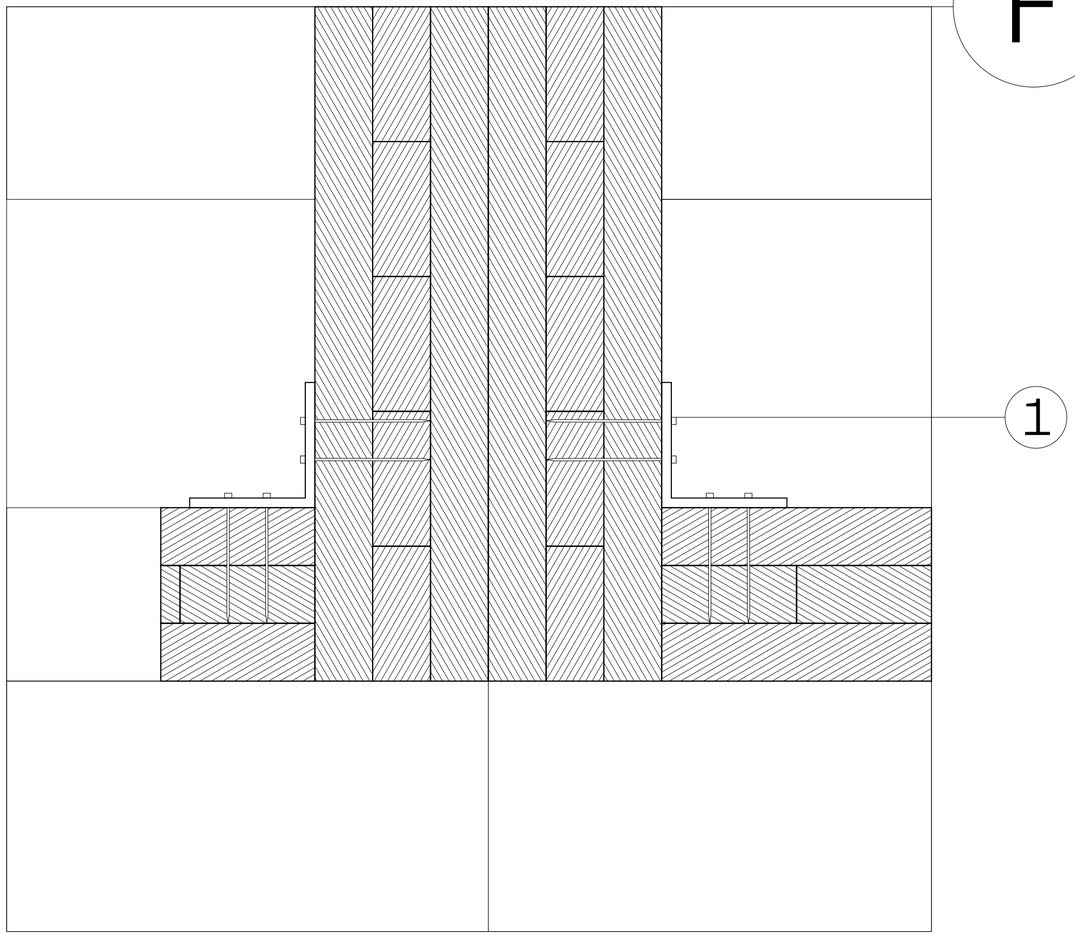


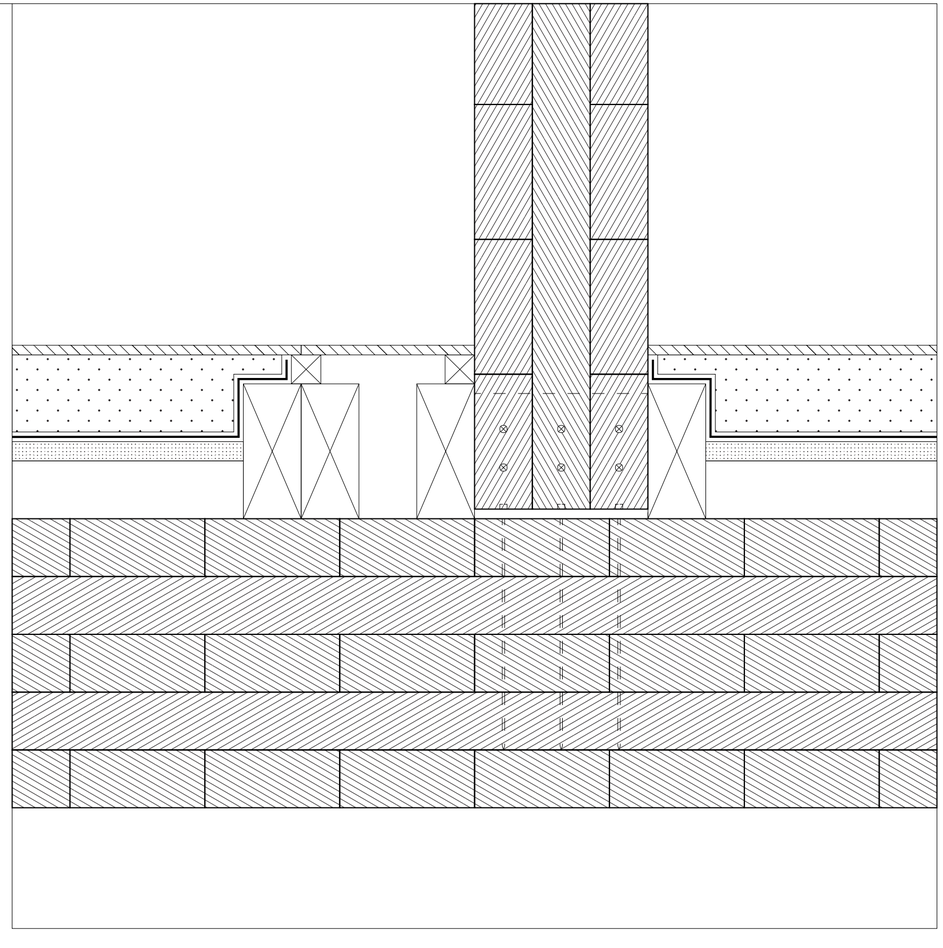
1. 2, 3-Ply CLT wall panels with half-lap joint

F



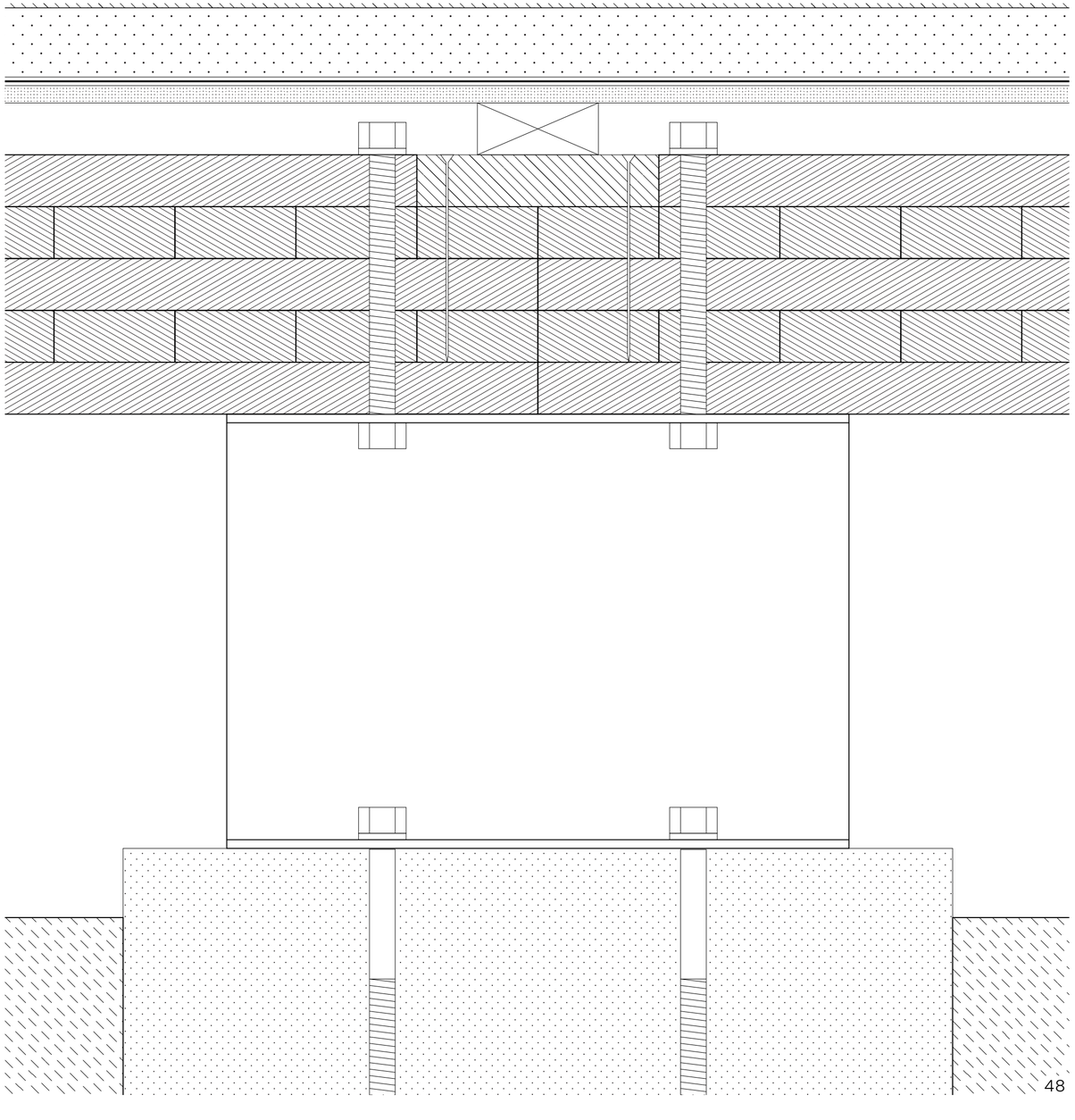
1. Steel bracket with self-tapping screws

G



1" 4"

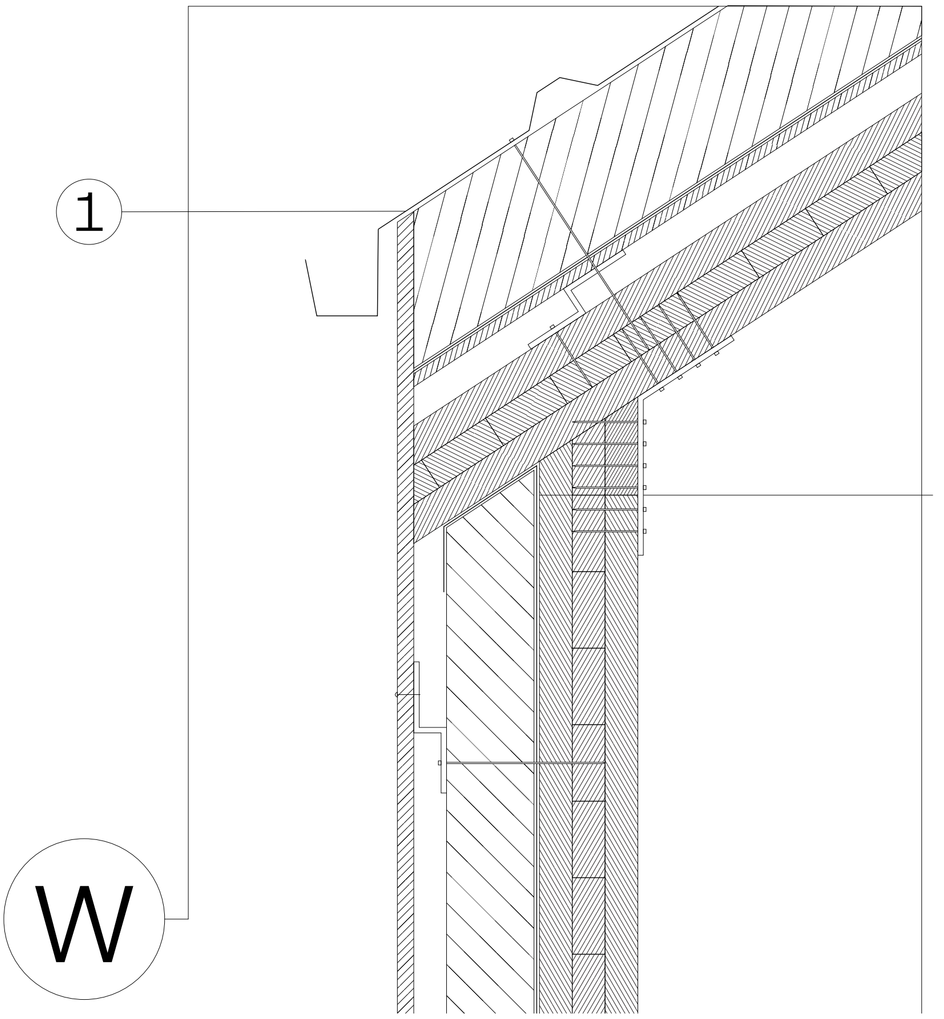
2" 8"

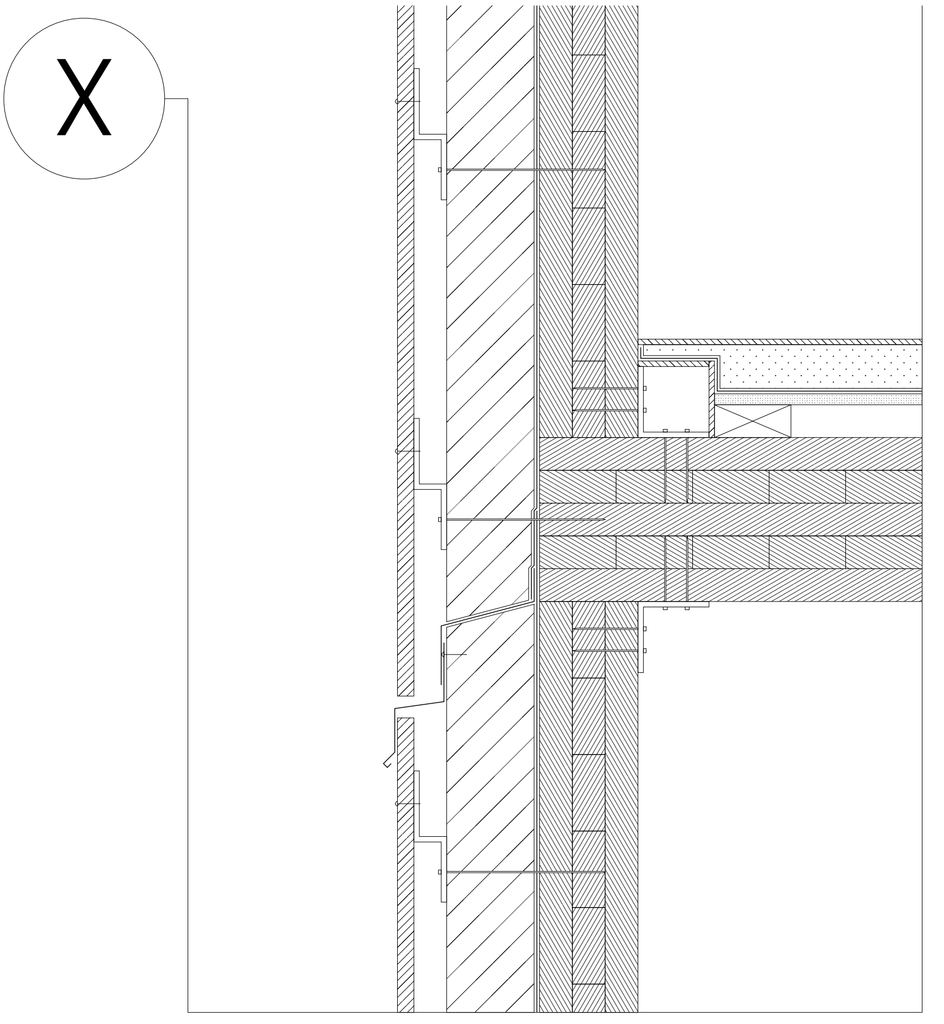


2'
4'
8'
16'
N

Z
Y
X
W

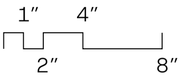
1. Corrugated metal roof

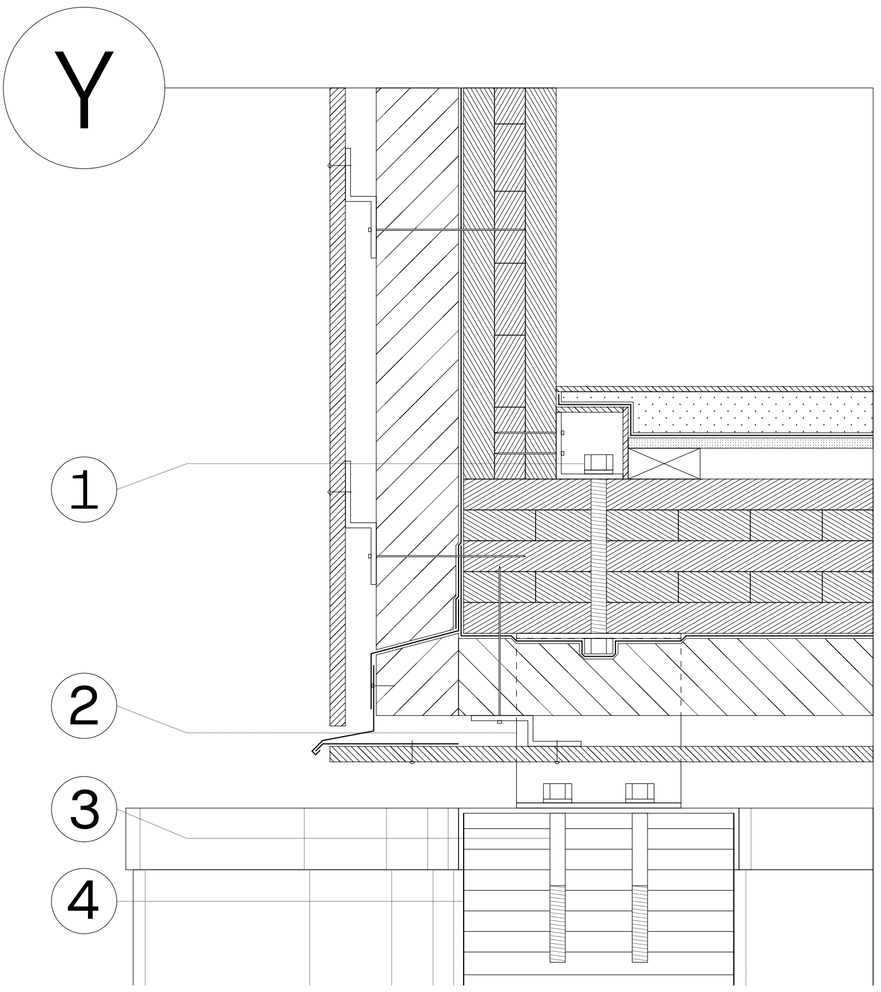


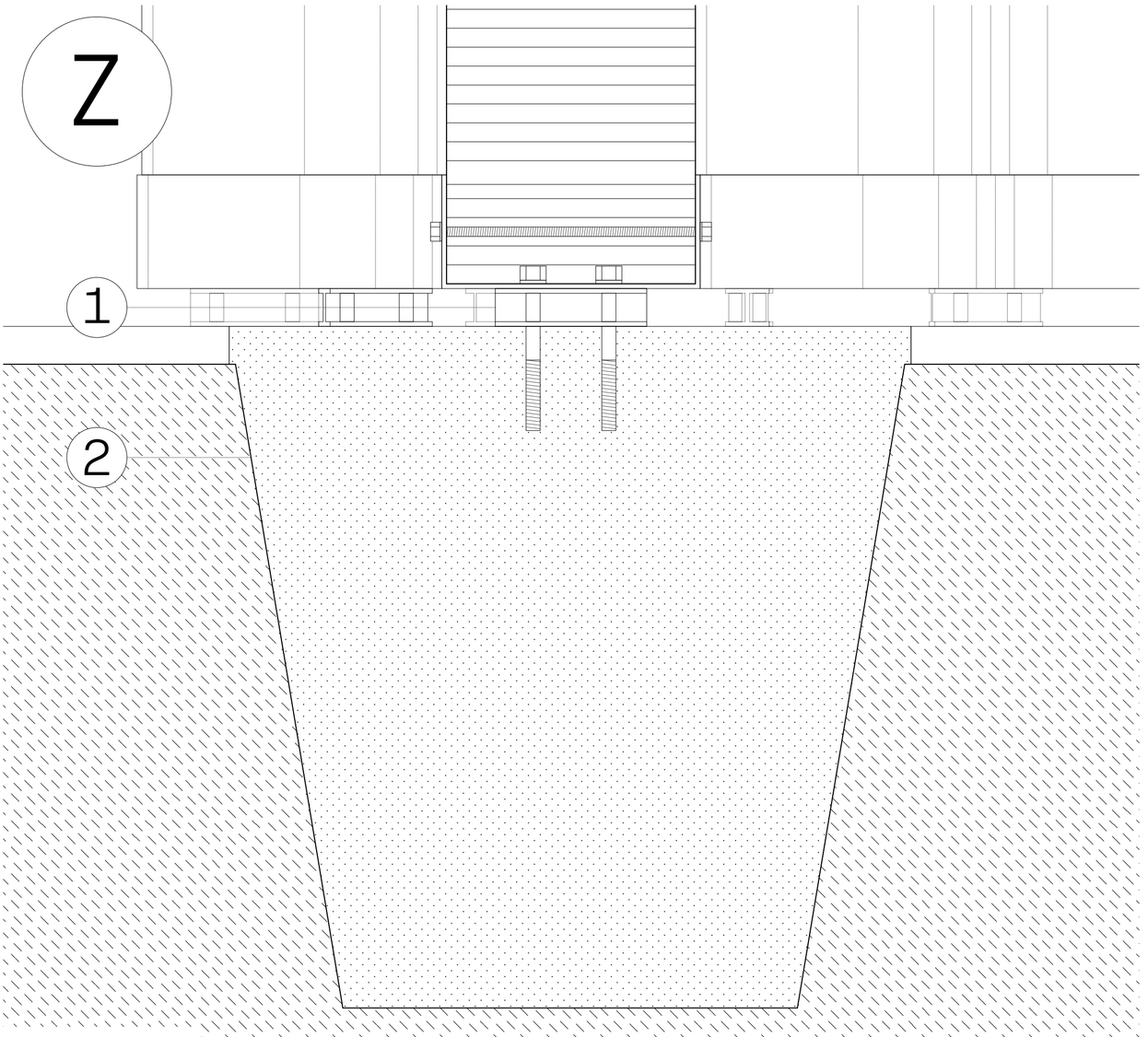


3/2″ 6″
3″ 1′

1. Threaded rod with bolts and washer
2. Steel W-beam
3. Anchor bolts with washers
4. 3D Printed wood pulp and resin wall

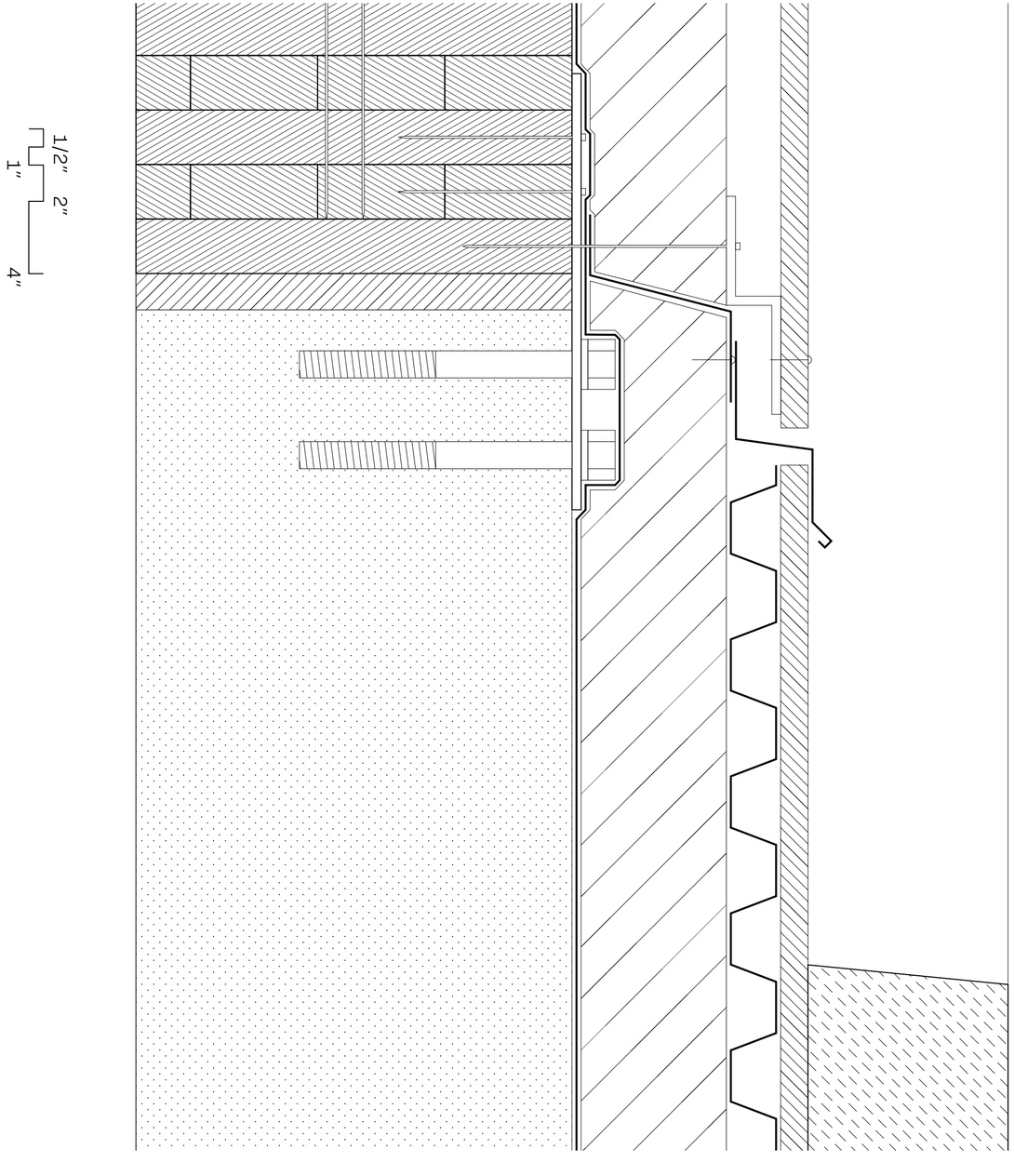






1. Steel H-beam

2. 3′ Concrete footing



The End

Before this project, I had never designed housing, I had never touched computer scripts, I had never used Grasshopper, I had never made a book, I had never made a module for anything, I had never really done detail drawings that were realistic, and I had certainly never designed and guided an architecture project of my own.

This project has taught me a great deal about architecture. It makes sense that alternative forms of housing are rare and prone to failure, designing them takes design intention that is extremely delicate and hard to pull off with any modicum of grace. Even if systems are simple and work together well, it does not make them efficient, affordable, or manageable.

This project taught me a lot about life. The finished product is not really all that important, what's important is that you strive to improve, either making yourself or the world better. I didn't make the world any better with this project, but I sure did improve myself. We'll worry about making the world better with the next project.

Although I worked on this project alone, it would not have been possible without many people's efforts and guidance. My committee and studio professor are responsible for much of the good work that ended up in this project. At the end of the day, this project was intended as a challenge and exploration of finding what I want from architecture. In that regard, it was success.

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Thank You

Thank you reader, for looking at my book,
even if you didn't really read it.

Thank you, my committee,
for teaching and guiding me.

Thank you, my family,
for everything.

Thank you, God(s) and/or Goddess(es),
for everything, literally.

If you are interested in my work or the script
I used for this project, check out my website,
cameronklepac.com.

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